Transport Canada
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TP 4980E

# ARCTIC MARINF TRANSPORTATION

# R&D PROGRAM

# ANNUAL REPORT: 1983-84

prepared by: Marine R&D/Energy
Planning, Programming & Finance Branch
Canadian Marine Transportation Administration

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## INTRODUCTION

This is the third annual report of the Arctic Marine Transportation R&D Program.

The report was prepared by Ms. Pat Gibson under the direction of Mr. W. Ellwood, Chief, Marine R&D and Energy. The program participants, the Canadian Coast Guard, Transportation Development Centre, Canarctic Shipping Company Ltd., the Department of Fisheries and Oceans and Department of the Environment are acknowledged both for their contribution to this program and for their assistance in the preparation of the report.

Comments, suggestions for improvements, and questions on the report may be directed to Ms. Gibson, Mr. Ellwood or myself at (613) 995-7324.

André P. Gagnon
Chairman
Interdepartmental Committee on
Marine Transportation R&D

# 1983/84 ANNUAL REPORT TO TREASURY BOARD, ARCTIC MARINE R&D PROGRAM

**BACKGROUND:**

TB Minute #778300, dated July 23, 1981 gave approval to Transport Canada (TC), Fisheries and Oceans (DFO) and Environment Canada (DOE) to implement an augmented mission-oriented R&D program in the area of Arctic marine transportation. The objective of this original 3-year program was to allow the three departments to establish appropriate regulations, and in conjunction with industry, more efficient and effective services necessary to permit safe shipments of Arctic resources on a year round basis.

The total funding authorized by Treasury Board for the Arctic Marine R&D program was $13,369.6k for the period 1981/82 - 1983/84. Transport Canada has since evaluated the program in 1983/84 and has applied to Treasury Board for authority to extend the program for 1984/85 and 1985/86. This latter request was successeful and Phase II (1984/85 - 1985/86) was approved with a budget of $12.766k.

Transport Canada was also directed to co-ordinate and prepare a report to Treasury Board annually, on behalf of the three departments involved, on the progress of the program. In its subsequent decisions, the TB has rescinded this requirement for formal submissions; however, the three departments involved have agreed to continue to compile an annual project status report for internal purposes.

Following is the third annual report which covers FY 1983/84. It is again divided into three sections:

1. Review of the Management Process
2. Financial Status
3. Project Status

**MANAGEMENT PROCESS:**

The original programming documents for the Arctic Marine R&D Program proposed that all resources be allocated to Transport Canada (CMTA) and managed by an Interdepartmental Committee made up of CMTA, TDC, DFO and DOE officers directly responsible for implementing the program. However, TB Minute #778300 directed that the program was to be funded through direct parliamentary appropriations to each of the departments. Transport Canada retained responsibility for the coordination of the annual planning; the periodic financial realignment among departments; the preparation of an annual report to Treasury Board on the status of the program; the program evaluation at the end of the first three years; and for resubmitting to Treasury Board thereafter to extend it for fiscal years 1984/85 and 1985/86.

Each of the three departments, TC, DFO and DOE has established a 5-year work plan for Arctic Marine R&D. The plans for DFO and DOE correspond to the project areas identified in the original programming documentation, while TC's plan is now organized according to CMTA's planning elements (i.e. Regulatory; Aids to Navigation; Icebreaking, Arctic and Other Ship Support etc).* The plans are updated throughout the year and are co-ordinated interdepartmentally by the Interdepartmental Committee on Arctic R&D which is chaired by the Chairman of the CMTA R&D Committee. The plans are recommended to internal senior management and subsequently incorporated into Departmental Operational Plans.

Transport Canada's share of the funds is managed by the CMTA R&D Committee which meets approximately every six weeks to review progress on the program and on other R&D matters. A comparable management function has been established by DFO and DOE for their internal purposes.

During Phase I (1981/82 - 83/84) of the Program, the CMTA R&D Committee maintained an expenditure control system for funds allocated to Transport Canada by assigning priorities and approving the commitment of funds to projects, while the Chairman authorized actual project expenditures by signing project justification forms completed by the individual project officers. As part of the evaluation of Phase I, a diagram of the Arctic Marine Transportation R&D Project Approval Process was prepared; a copy of which is attached as Appendix A. Also attached is a copy of the Logic Model for the program.

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* Treasury Board approval was obtained to change the plan from the original TB submission.

To facilitate interdepartmental co-ordination of the Arctic Marine R&D Program, a compatible project justification form has been established for the three departments. The Chairman of the CMTA R&D Committee also chairs an expanded Interdepartmental Committee on Arctic Marine R&D made up of Transport Canada, Fisheries and Oceans, Environment Canada, Department of Regional Industrial Expansion, National Research Council, Public Works, Energy, Mines and Resources, Canada Oil and Gas Lands Administration and National Defence. This Committee reviews the status of the Arctic Marine R&D Program, considers opportunities to adjust budget allocations between departments if necessary, and plans for future R&D activities related to Arctic marine transportation.

DRIE was added to the Committee at the request of Treasury Board (TB Minute 785827, April 5, 1983) who asked that a knowledgeable representative from DRIE be charged with the responsibility of ensuring project activity is designed to maximize industrial (technical) scientific spin-off R&D.

**FINANCIAL STATUS:**

Funds totalling $13,369.6k were authorized by Treasury Board for the Arctic Marine Transportation R&D Program for Phase I, 1981/82 to 1983/84. The funds were to be used to augment existing Arctic marine R&D work. The breakdown between the departments and years is as follows:

($000)

| | TC | DFO | DOE | TOTAL |
|---|---|---|---|---|
| 1981/82 | 1,048.6 | 500.0 | 359.8 | 1,908.4 |
| 1982/84 | 4,528.1 | 795.8 | 434.8 | 5,758.7 |
| 1983/84 | 3,951.9 | 1,190.8 | 559.8 | 5,702.5 |
| TOTAL | 9,528.6 | 2,486.6 | 1,354.4 | 13,369.6 |

The program is funded through direct parliamentary appropriation to each participating department.

In addition to financial resources, the TB submission also asked for 26 PY's for Arctic Marine R&D over the three year program, 4 in 1981/83, 10 in 1982/83 and 12 in 1983/84. The PY request was rejected and the departments were instructed to provide the required PY's from their own approved PY authorities. However, as the three departments believed that additional PY's were necessary, Transport Canada made a separate submission to Treasury Board and the PY's for 1982/83 and 1983/84 were approved (TB Minute 786033, February 21, 1983).

The 1981/82, 1982/83 and 1983/84 financial results, are summarized in Table I, and the financial status of individual projects is contained in Table II.

TABLE I

($ x 1000)

| | | TC | DFO | DOE | TOTAL |
|---|---|---|---|---|---|
| 1981/82 | Allocation | 1,048.600 | 500.000 | 359.800 | 1,908.400 |
| | Expenditures | 1,048.408 | 396.000 | 274.000 | 1,718.408 |
| | Lapse | 0.192 | 104.000 | 85.800 | 189.992 |
| | % Lapse | 0.02% | 20.80% | 23.85% | 9.96% |
| | # of Projects | 12 | 3 | 3 | 18 |
| 1982/83 | Allocation | 4,528.100 | 795.800 | 434.800 | 5,758.700 |
| | Expenditures | 3,511.526* | 1,214.600 | 444.208 | 5,170.334 |
| | Lapse | 1,016.574 | (418.800) | (9.408) | 588.366 |
| | % Lapse | 22.40% | -52.63% | -2.16% | 10.21% |
| | # of Projects | 50 | 3 | 4 | 57 |
| 1983/84 | Allocation | 3,951.900 | 1,190.800 | 559.800 | 5,702.500 |
| | Expenditures | 3,924.008* | 1,095.100 | 584.600 | 5,603.708 |
| | Lapse | 27.892 | 95.700 | (24.800) | 98.792 |
| | % of Lapse | 0.70% | 8.04% | -4.43% | 1.73% |
| | # of Projects | 44 | 3 | 4 | 51 |
| TOTAL | Allocation | 9,528.600 | 2,486.600 | 1,354.400 | 13,369.600 |
| | Expenditures | 8,483.942 | 2,705.700 | 1,302.808 | 12,492.450 |
| | Lapse | 1,044.658 | (219.100) | 51.592 | 877.150 |
| | % Lapse | 10.96% | -8.81% | 3.80% | 6.56% |

* Transport Canada transferred $796.369k of its allotment to DFO and $50k to DOE in 1982/83. DFO transfered $145k of this back to TC in 1983/84. The figures shown do not reflect this transfer.

Because of the large number of projects and the uncertainity of start up and rate of progress on R&D projects, TC uses an over-commitment approach to managing its funds.

TABLE II
1983/84 Project Summary

($ x 1000)

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| TRANSPORT CANADA | | | | | |
| Canadian Coast Guard (CCG) | | | | | |
| RUDDERS, STOCKS AND STEERING GEAR | 2007 | | | 29.000 | 29.000 |
| DOME MV CANMAR KIGORIAK | 2008 | | 30.000 | | 30.000 |
| MV ARCTIC - HULL STRUCTURE FIELD TESTS | 2009 | | | 165.000 | 165.000 |
| POLAR 8 ICEBREAKER DEPLOYMENT R&D | 2010 | | 13.931 | 214.00 | 227.931 |
| MV ARCTIC HULL GIRDER STRESS INVESTIGATION | 2011 | 106.101 | | | 106.101 |
| VIBRATORY RESPONSE DESIGN LOADS AND CRITERIA | 2012 | 305.776 | 145.648 | | 451.424 |
| MV ARCTIC STATISTICAL MEASURING SYSTEM (1982) | 2015 | | 297.364 | 10.300 | 307.664 |
| MV ARCTIC - NON DESTRUCTIVE TESTS | 2018 | | 50.000 | | 50.000 |
| MV ARCTIC - DESTRUCTIVE TESTS | 2019 | | 15.129 | | 15.129 |
| MV ARCTIC - MONITORING OF MACHINERY COMPONENTS | 2023 | | 53.982 | | 53.982 |
| STRUCTURAL STEEL STANDARDS - ARCTIC SHIPS | 2031 | | 2.500 | 32.000 | 34.500 |
| REQUIREMENTS AND TESTS FOR STRUCTURAL STEEL | 2038 | 9.950 | | | 9.950 |
| ARCTIC SHIP NAVIGATION PROCEDURES | 2042 | | | | |

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| GROUP IV STUDIES | 2043 | | 91.671 | 128.000 | 219.671 |
| FURTHER REGULATION REVISIONS | 2044 | | | | - |
| FISHING VESSELS IN ARCTIC AND SUBARCTIC CONDITIONS | 2047 | | | 30.000 | 30.000 |
| SHIP ARRANGEMENTS STUDY | 2048 | | | | - |
| LOAD LINES AND STABILITY ARCTIC SHIPS | 2049 | | | 45.000 | 45.000 |
| ADDITIONAL MACHINERY REQUIREMENTS | 2050 | | | | - |
| ARCTIC OPERATIONS - MANNING | 2051 | | | 75.750 | 75.750 |
| CREW ACCOMODATION ON ARCTIC CLASS SHIPS | 2053 | | | 38.000 | 38.000 |
| SURVEY, REPAIR AND SALVAGE TECHNIQUES IN THE ARCTIC | 2054 | | | 46.000 | 46.000 |
| FREQUENCY AGILE RACON (FAR) | 2059 | | 80.066 | 50.000 | 130.066 |
| COMMUNICATIONS CONTROL CONSOLE | 2065 | | | 400.000 | 400.000 |
| MF/HF ANTENNA MEASUREMENTS - RADIO PROP. | 2066 | | 18.560 | | 18.560 |
| ARCTIC COMMUNICATIONS - PRE ENGINEERING | 2067 | | 83.010 | | 83.010 |
| ARCTIC LIFESAVING, SURVIVAL AND RESCUE | 2071 | | 7.156 | 102.000 | 109.156 |
| R&D PROJECT MANAGEMENT | 2079 | | | 6.000 | 6.000 |
| DEVELOPMENT OF ARCTIC POWER SUPPLIES | 2080 | | 41.210 | 35.000 | 76.210 |
| CONTAINERIZED NAV-AID UNIT | 2081 | | 28.216 | 8.000 | 36.216 |

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| OIL BOOM EVALUATION | 2082 | | 19.043 | | 19.043 |
| STIRLING CYCLE GENERATOR | 2093 | | | 70.000 | 70.000 |
| PARTICIPATION WITH CANMAR/KIGORIAK AND ROBERT LFMEUR | 2094 | | | 530.000 | 530.000 |
| FUEL SUPPLY TO POLAR ICEBREAKER STUDY | 2095 | | 54.000 | 20.000 | 74.000 |
| OPERATION OF DIESEL ENGINES IN LIFEBOATS | 2096 | | 5.920 | 42.000 | 47.920 |
| NORTHWEST PASSAGE COMMUNICATION EXPERIMENT | 2097 | | | 17.000 | 17.000 |
| GUIDELINES AND INSTRUCTIONS FOR MATES AND MASTERS | 2098 | | | | - |
| ICE CRUSHING STRENGTH RESEARCH | 2101 | | 44.994 | 46.000 | 90.994 |
| ICE FAILURE MODES | 2102 | | 75.638 | | 75.638 |
| STUDY OF SPEED/POWER LOSS OF VESSELS IN ICE | 2104 | | | 17.000 | 17.000 |
| PREPROJECT STUDIES FOR A SHIP HANDLING SIMULATOR | 2106 | | | | - |
| MV ARCTIC BRITTLE FRACTURE RISK | 2109 | | 26.000 | 4.000 | 30.000 |
| TRAFFICABILITY STUDY ON MV COLUMBIALAND | 2111 | | 16.940 | | 16.950 |
| LIFESAVING EQUIPMENT FOR ARCTIC CLASS SHIPS | 2125 | | | 73.000 | 73.000 |
| MODELLING OF BROKEN ICE AROUND AN ICEBREAKER | 2129 | | | 91.000 | 91.000 |

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| Transport Development Centre (TDC) | | | | | |
| HULL STRENGTH POLAR SEA-ICE INDUCED VIBRATION | 2003 | 8.000 | 10.877 | | 18.877 |
| HULL STRENGTH POLAR SEA PHASE IV | 2004 | | 52.058 | | 52.058 |
| HULL STRENGTH POLAR SEA PHASE V | 2005 | | 211.582 | 169.874 | 381.456 |
| DEDICATED ANALYSIS MV ARCTIC | 2014 | 28.498 | 124.024 | 96.001 | 248.523 |
| MV ARCTIC - OPTIMIZATION OF BOW FORM | 2017 | | 120.950 | 174.213 | 295.163 |
| DEVELOPMENT OF SEMI-EMPERICAL ICE RESISTANCE MODEL | 2024 | 33.408 | 36.347 | | 69.755 |
| SHIP STRUCTURAL RESPONSE MODEL | 2025 | | 43.735 | | 43.735 |
| FULL SCALE DATA COLLECTION PROGRAM | 2026 | | | | - |
| ICE CLASS PROPELLER DEVELOPMENT | 2027 | 3.438 | 148.249 | | 151.687 |
| PROPELLER PROTECTION IN ICE | 2029 | | 2.908 | | 2.908 |
| MV ARCTIC HEAT FLOW MEASUREMENTS | 2039 | 45.015 | 0.302 | | 45.317 |
| EXTERNALLY PRESSURIZED STERN TUBE BEARINGS | 2040 | 82.406 | 196.976 | 111.492 | 390.874 |
| WAVE CLIMATE STUDY ARCTIC AND OFFSHORE | 2046 | | 19.140 | | 19.140 |
| HIGH INTENSITY LIGHT SYSTEM | 2055 | | | | - |
| ICE HAZARD DETECTION AND COLLISION AVOIDANCE | 2057 | | 151.390 | 118.948 | 270.338 |

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| REMOTE SEA ICE THICKNESS SENSOR | 2058 | | 19.552 | 202.450 | 222.002 |
| CONCEPTUAL PLAN OF R&D OPTIONS-MARINE SIMULATOR | 2064 | 18.991 | 62.547 | 70.081 | 151.619 |
| AIR CUSHION PLATFORM ICEBREAKING (ACIB) EVALUATION | 2070 | 404.325 | 447.954 | 131.647 | 983.926 |
| MAINTENANCE OF ARCTIC PORTS AND HARBOURS | 2072 | 2.500 | 59.632 | | 62.132 |
| CONSTRUCTION STANDARDS FOR ARCTIC PORTS HANDBOOK | 2073 | | 29.354 | 53.000 | 82.354 |
| MV ARCTIC - BRITTLE FRACTURE | 2109 | | 25.000 | 4.000 | 29.000 |
| FUELLING - POLAR SEA (1983) | 2112 | | 173.020 | | 173.020 |
| ULTRASONIC DOPPLER VELOCIMETER | 2113 | | 74.090 | | 74.090 |
| NAWS HULL STRESS WARNING SYSTEM | 2115 | | 19.835 | 59.119 | 78.954 |
| CONCEPTS FOR MARINE SURVIVAL CAPSULE | 2116 | | 14.765 | 0.133 | 14.898 |
| ICE LOADS ON FISHING VESSELS | 2131 | | | 30.000 | 30.000 |
| **Canarctic Shipping Ltd.** | | | | | |
| MV ARCTIC - REARRANGEMENT OF BALLAST WATER | 2020 | | 61.096 | | 61.096 |
| MV ARCTIC - IMPROVEMENTS IN ICE NAVIGATION | 2021 | | 12.610 | 268.000 | 280.610 |
| MV ARCTIC - ICE REGIME STUDIES | 2022 | | 156.717 | | 156.717 |
| MC ARCTIC CONTINGENCY | 2075 | | 17.358 | | 17.358 |

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| DMPF/CMRD | | | | | |
| UPDATE OF ARCTIC RESEARCH | 2103 | | 9.980 | | 9.980 |
| CANADA/JAPAN R&D COOPERATION: PROJECT STUDIES | 2105 | | 8.500 | 43.000 | 51.500 |
| ARCTIC MARINE R&D PROGRAM EVALUATION | 2107 | | | 68.000 | 68.000 |
| PROJECT TOTALS | | 1,048.408 | 3,511.526 | 3,924.008 | 8,483.942 |
| TRANSFER TO DFO* | | | 796.369 | (145.000) | 651.369 |
| TRANSFER TO DOE* | | | 50.000 | | 50.000 |
| | | 1,048.408 | 4,357.895 | 3,779.008 | 9,185.311 |

* TC transfered $796.369k to DFO and $50k to DOE in 1982/83 to allow these departments to accelerate work on their projects. DFO transfered $145k back to TC in 1983/84.

TABLE III
1983/84 Project Summary

($ x 1000)

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| DFO | | | | | |
| ARCTIC SFA ICE STUDIES | 67125 | 150.000 | 386.900 | 529.100 | 1,066.000 |
| UNDERWATER ACOUSTIC CONTROLLED SUBMERSIBLE | 66309 | 46.000 | 492.000 | 500.000 | 1,038.000 |
| CLEARANCE SWEEPING OF NAVIGATION CORRIDORS | 66310 | 200.000 | 335.700 | 66.000 | 601.700 |
| TOTAL PROJECTS (DFO) | | 396.000 | 1,214.600 | 1,095.100 | 2,705.700 |
| TRANSFER FROM TC* | | | (796.369) | 145.000 | (651.369) |
| TOTAL (DFO) | | 396.000 | 418.231 | 1,240.100 | 2,054.331 |

TABLE IV
1983/84 Project Summary

($ x 1000)

| PROJECT TITLE | PROJECT # | 1981/82 EXPEND. | 1982/83 EXPEND. | 1983/84 EXPEND. | TOTAL |
|---|---|---|---|---|---|
| DOE | | | | | |
| MARINE FORECAST SYSTEM | 1 | 73.600 | 117.000 | 168.900 | 359.500 |
| MICROWAVE SENSING OF ICE | 2 | 152.700 | 150.000 | 200.000 | 502.700 |
| LASER PROFILOMETER | 3 | | 50.000 | 57.000 | 107.000 |
| OIL SPILL STUDIES AND CONTINGENCY PLANNING | 4A, B, C, | 47.700 | 127.208 | 158.700 | 333.608 |
| TOTAL PROJECTS (DOE) | | 274.000 | 444.208 | 584.600 | 1,302.808 |
| TRANSFER FROM TC* | | | (50.000) | | (50.000) |
| TOTAL (DOE) | | 274.000 | 394.208 | 584.600 | 1,252.808 |
| TOTAL (ARCTIC) | | 1,718.408 | 5,170.334 | 5,603.708 | 12,492.450 |

**PROJECT STATUS:**

This section of the report contains short summaries on each of the projects on which work was done in 1983/84. The information contained on these sheets includes the department/ components, the project title and number (if appropriate), 1983/84 expenditure, the project officer, the contractor, the departmental objective, a brief project description, the status of the project, reports received, and a brief description of industrial, technical and/or scientific opportunities presented.

TRANSPORT CANADA

CANADIAN COAST GUARD (CCG)

| | |
|---|---|
| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Rudders, Stocks and Steering Gear on Arctic Class Ships |
| Project Number: | 2007 |
| 1983/84 Expenditure: | $29,000 |
| Project Officer: | C. Norris |
| Contractor: | Arctec Canada Ltd. |
| Departmental Objective: | To provide DGSS with sufficient scientific data to promulgate construction standards and design criteria for rudders, steering gear and their components on Arctic class ships, to maintain safe and efficient marine transport. |
| Project Description: | To investigate the rudder and rudder components/ice interaction phenomenon and resultant effects on steering gear components by model and full scale testing. Testing to be carried out for open and ice-infested waters.<br><br>To collate, review, and analyze rudder and steering gear damage reports, and results of material analysis, due to ice interaction.<br><br>To evaluate the use of rudder and steering gear protective devices, i.e. ice horns, locking devices, stern configuration, hydraulic pressure relief devices, high versus low presure systems or a combination, etc.<br><br>To develop a failure mode analysis model for rudder, steering gear and components.<br><br>To reduce data to engineering terms for analysis to provide a coherent picture of the rudder and steering gear/ice interaction phenomenon, and for development of minimum standards and design criteria. |
| Status: | Active |

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|---|---|
| Reports/Deliverables: | Reports documenting techniques, tests, data, results, conclusions and recommendations. Final Report TP 5372E. |
| Industrial/Technical/ Scientific Opportunity: | Participation by and/or benefits for equipment manufacturers; owners/operators of vessels navigating in ice infested waters, i.e. material selection, component strength requirements, rudder/steering gear selection criteria. |

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|---|---|
| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Dome M.V. Canmar Kigoriak Tests (1981) |
| Project Number: | 2008 |
| 1983/84 Expenditure: | - |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Dome Petroleum - Arctic Marine R&D Division |
| Departmental Objective: | - Updating the CASPPR's<br>- Arctic Marine Transportation R&D<br>- Transportation of Energy Commodities. |
| Project Description: | 2 periods of field testing completed successfully in August and October 1981. Final report received and accepted. |
| Status: | Complete in all respects. |
| Reports/Deliverables: | Final report entitled "Full Scale Measurements of the Ice Impact Loads and Response of the Kigoriak, August and October 1981". Report not available to general public due to proprietary nature of contents. |
| Industrial/Technical/ Scientific Opportunity: | This research provides considerable background for the proponent, Dome/Canmar, to assist in the design of future icebreaking vessels. When the information becomes public, similar opportunity will exist for other Arctic operators. Meanwhile, the data is being used by CG in studies updating the ASPP Regulations. |

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|---|---|
| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | MV Arctic Dedicated Field Test Ship/Ice Interaction |
| Project Number: | 2009 |
| 1983/84 Expenditure: | $165,000 |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Arctec Canada Ltd. (with US Arctec Inc.)<br>Dr. Frederking, NRC/DBS<br>Dr. Williams, NRC/AVMRI |
| Departmental Objective: | Updating the structural requirements of the Arctic Shipping Pollution Prevention Regulations.<br><br>Arctic marine transportation development.<br><br>Transportation of energy commodities.<br><br>Offshore structures and mobile offshore drilling units. |
| Project Description: | The specific objectives are:<br><br>a) to determine the total bow force when the MV Arctic rams multi-year ice.<br>b) to determine the hull girder response to total bow force including accelerations and rigid body motions.<br>c) to extrapolate the above to higher ramming speeds.<br>d) derive an ice force penetration model. |
| Status: | Active |
| Reports/Deliverables: | Final report once the study is completed. |
| Industrial/Technical/ Scientific Opportunity: | Besides promoting the expertise of the scientific companies and personnel involved, successful completion will be a major advance in the field of ship/ice interaction. Canada will have established a tangible lead; Arctic ship design will be significantly improved. |

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|---|---|
| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Polar 8 Icebreaker Deployment - R&D Onboard Data Acquisition System Specification |
| Project Number: | 2010 |
| 1983/84 Expenditure: | $214,000 |
| Project Officer: | I.K. Leslie, Coast Guard Northern Branch |
| Contractor: | Arctec Canada Limited |
| Departmental Objective: | Support future icebreaker design and operational programs<br><br>Ship performance parameters will be recorded and be used to ensure minimum energy utilisation throughout operational cycle.<br><br>Interface with alarm system to indicate when ship performance or subsystems are reaching design limits. |
| Project Description: | The project consisted of development of system requirements through assessment of operational objectives. Concept studies were carried out to determine the feasibility of systems to meet these objectives and to identify likely system components and to agree upon a desirable and achievable system configuration, with indication of costs. Draft specifications were prepared for inclusion in the final version of the ship specifications. |
| Status: | Contract completed with all reports submitted. |
| Reports/Deliverables: | Arctec Canada report title "Polar 8 Icebreaker Scientific Data Acquisition System Study". |
| Industrial/Technical/ Scientific Opportunity: | Report presents overview of instrumentation requirements to meet scientific objectives of assessing overall ship performance in ice. |

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|---|---|
| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | a) MV Arctic Hull Stress Investigation; and<br>b) Vibratory Response design Loads and Criteria |
| Project Number: | 2011/2012 |
| 1983/84 Expenditure: | - |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Melville Shipping Limited |
| Departmental Objective: | This work arises directly from CCG's mandate to ensure the safety of ships navigating in Canadian Arctic waters by updating the Arctic Shipping Pollution Prevention Regulations made under the Arctic Waters Pollution Prevention Act. |
| Project Description: | a) to measure stresses (amplitude and frequencies) during ramming of MV Arctic.<br>b) to estimate from data the fatigue life of the MV Arctic hull girder.<br>c) to estimate the bow force on impact at varying speed field measurement; analog recording of stresses, acceleration, ship speed and condition, video icebreaking process, detailed ice particulars. Analysis included a mathemacial model of ship/ice interaction. |
| Status: | Completed |
| Reports/Deliverables: | a) measurement of Hull Girder Bending Strain and Vibration on the MV Arctic in Admiralty Inlet July 1981.<br>b) measurement of Hull Girder Strains and Vibrations during Ramming of Multi-Year Ice Floes - Lancaster Sound November 1981.<br>c) continuation of Stress Analysis MV Arctic Dynamic Exciter Test.<br>d) continuation of Stress Analysis Mathematical Model of the Hull Girder Structure of MV Arctic.<br>Reports released to Canadian companies involved in Arctic ship research. |

Industrial/Technical/
Scientific Opportunity: Melville Shipping Limited gained valuable experience in onboard data collection during ship/ice interaction. Also they and other Canadian organizations benefited from the technology transfer from the Finnish sub-contractor - a recognized leader in all aspects of ship/ice interaction.

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|---|---|
| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | MV Arctic Statistical Measuring System 1982 |
| Project Number: | 2015 |
| 1983/84 Expenditure: | $10,300 |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Technical Research Centre of Finland (VTT)<br>Arctec Canada |
| Departmental Objective: | - Updating of the Arctic Shipping Pollution Prevention Regulations<br>- Structural requirements and structural steels<br>- Design of large Arctic Class Ships |
| Project Description: | Four groups of strain gauges were installed on board the M/V Arctic:<br>(a) Gauges on bow structure to measure the ice loads acting on plating, frames, stringers and web frames.<br>(b) Gauges on one cross section (fr. 140) to measure the shear force on that cross section.<br>(c) Gauges on deck to measure the longitudinal stress distribution.<br>(d) Gauges on shell at bilge in way of fore end of bilge keel to detect any stress concentration or anomaly. |
| Status: | Completed. All reports submitted. |
| Reports/Deliverables: | (a) M/V Arctic Statistical Data Measuring System 1982.<br>(b) Results of Statistical Measuring System on Board M/V Arctic 1982.<br>Reports issued to Canadian organizations involved in Arctic ship research. |
| Industrial/Technical/ Scientific Opportunity: | The technology transfer from VTT (Technical Research Centre of Finland) to Canada was significant on this job. This applied to the data collection system, the methods and analysis. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | MV Arctic Non-Destructive Testing and Inspection Hull Structure |
| Project Number: | 2018 |
| 1983/84 Expenditure: | - |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Scientific Advisor: L.P. Trudeau - Consultant Metallurgist. CANMET, EMR, Canarctic Shipping Company Limited. |
| Departmental Objective: | The project is clearly related to Coast Guard's mandate with respect to safety under the Canada Shipping Act and with respect to pollution prevention under the Arctic Waters Pollution Prevention Act. It is also related to the setting of structural steel standards under the CASPP regs. It comes under the CMTA policy goal of promoting Arctic Marine Transportation. |
| Project Description: | a) The structual drawings were studied and specific areas, structural members and connections selected for inspection.<br>b) The methods of non-destructive testing most appropriate to the parts selected for inspection were chosen - magnetic particle, X-Ray, etc.<br>c) The work was carried out at ADM drydock, Amsterdam, Holland in June 1982. |
| Status: | Completed |
| Reports/Deliverables: | Report on Non-Destructive Testing Program Carried Out on MV Arctic June 1982. Limited distribution due to confidential nature of data with respect to owners interest. |
| Industrial/Technical/ Scientific Opportunity: | Important data input to CANMET's program on marine materials. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Destructive Testing of Further Selected Samples of Hull Structure |
| Project Number: | 2019 |
| 1983/84 Expenditure: | - |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Canarctic Shipping Company Ltd. (This project was contracted with the non-destructive test) |
| Departmental Objective: | Safety and Pollution Prevention under the CSA and AWPPA Arctic Marine Transportation R&D. |
| Project Description: | a) Sampling points on structure identified<br>b) Design cut outs and submitted for approval to Ship Safety and Classification Society.<br>c) Samples to EMR CANMET laboratory for testing.<br>d) Reporting |
| Status: | Completed |
| Reports/Deliverables: | MV Arctic Steel Samples Test Report. In-house use. |
| Industrial/Technical/ Scientific Opportunity: | Part of R&D data on steels for Arctic Class Ships. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | MV Arctic Monitoring Machinery Components During Ice Ramming |
| Project Number: | 2023 |
| 1983/84 Expenditure: | - |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Arctec Canada Limited |
| Departmental Objective: | Updating Arctic Shipping Pollution Prevention Regulations; Arctic Marine Transportation R&D |
| Project Description: | The objective was to identify and quantify the effects of ship response to icebreaking on machinery components. Carried out November/1982.<br><br>a) Visit ship and with the assistance of engine room staff identify components which to be monitored. In addition, previous Chief Engineers contacted. Instruments fitted the O/D box (CP propeller control) and the propeller shaft.<br><br>b) The manufacturers of the major components were consulted; LIPS HOLLAND<br><br>c) The vibratory response modes of the ship are now fairly well established, but some additional sensing for vibratory behaviour was placed in the machinery spaces. |
| Status: | Completed. Final Report received. |
| Reports/Deliverables: | MV Arctic Machinery Monitoring. Limited distribution because of small scope of project. |
| Industrial/Technical/ Scientific Opportunity: | Experience was gained by Arctec Canada in this specialized work. Further work is contemplated but resources not available. Data is needed re. the response of machinery systems during ship/ice interaction. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Structural Steel Standards - Arctic Class Ships |
| Project Number: | 2031 |
| 1983/84 Expenditure: | $32,000 |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | L.P. Trudeau, Consultant Metallurgist.<br>Det Norske Veritas Canada Limited<br>Arctec Canada |
| Departmental Objective: | Arctic ship safety regulation |
| Project Description: | To carry out a limited study in a support of the contention that the use of grade E in some areas or grade D steels as specified in the unified standards of the international association of classification societies would reduce the risk of brittle fracture to acceptable levels far below that with the use of grades A, B or C.<br><br>The work would involve: reference to previous work; evaluation of present quality control standards and welding standards. Investigation of the feasibility and cost of specifying a higher dynamic test (Charpy V) value of ensuring higher crack arrest capability for a possible trade-off in the extent of E grade fitted.<br><br>The aim is to prove that the Canadian Steel industry can meet a suitable standard with present production, quality control and welding techniques.<br><br>The use of higher quality steels for design considerations would not be precluded. They would be considered under section 11 of the ASPP Regs, on equivalency until such time as more comprehensive standards can be prepared.<br><br>A comparison with other available steels would be made. |
| Status: | Complete |

Reports/Deliverables:

(a) Interim Structural Steel Standards for Arctic Class Ships by L.P. Trudeau.

(b) Discussion paper on Interim Structural Steel Standards for Arctic Class Ships by J.S. McCallum, CGNS/T.

(c) Canadian Sub-Arctic Temperature Parameters for Structural Steel Standards by Arctec Canada Ltd.

(d) Interim Structural Standards for Arctic Class Ships-Evaluation and Commentary on Discussion Paper-DNV.

Industrial/Technical/ Scientific Opportunity:

The setting of such standards would enhance the ability of the Canadian Steel and Shipbuilding industry to serve the Arctic Marine Transportation Industry. The report would also be of considerable value to ship designers in considering their choice of steels.

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Group IV Studies |
| Project Number: | 2043 |
| 1983/84 Expenditure: | $128,000 |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Arctec Canada Limited |
| Departmental Objective: | - Updating Arctic Shipping Pollution Prevention Regulations<br>- Arctic marine transporation development<br>- Transportation of energy commodities. |
| Project Description: | The objective of the work is to update the ASPPR, provide the best possible statement of Arctic ice distribution for policy decisions on structural strength, develop a ship/ice collision probability model, and make recommendations on regulatory application, total bow force and local ice pressure. |
| Status: | Active |
| Reports/Deliverables: | a) Development of specifications for Arctic Shipping Probability Evaluation Network (ASPEN).<br>b) Group III Studies Supporting Update of CASPP Regulations ASPEN - "Arctic Shipping Probability Evaluation Network"<br>c) Interim reports Model in its final form will be available for use by Canadian interests. |
| Industrial/Technical/ Scientific Opportunity: | Increased capability in Arctic Marine Transportation assessment. Increased Canadian competence in problem solving by probability methods. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Fishing Vessels in Arctic and Sub-Arctic Conditions |
| Project Number: | 2047 |
| 1983/84 Expenditure: | $30,000 |
| Project Officer: | J. Grinstead, Coast Guard Northern Branch |
| Contractor: | Arctec Canada Ltd. |
| Departmental Objective: | To determine what standards additional to those existing at present are necessary to promote the safety of life on and pollution from fishing vessels in Arctic and Sub-Arctic waters. |
| Project Description: | - To review the present and projected numbers with respect to fishing vessel operation in Arctic and Sub-Arctic operations.<br>- To evaluate the efficacy of the existing regulatory regime when applied to this extended operation.<br>- To demarcate the application of the Arctic Shipping Pollution Prevention Regulations.<br>- To delineate aspects for detailed study notably structural strength, stability, working practices, working clothing, accommodation, lifesaving equipment and survival in emergencies. |
| Status: | Completed |
| Reports/Deliverables: | TP 5375E - Study of Regulatory Requirements for Fishing Vessels Operating in the Arctic and Sub-Arctic Sea Areas of Canada. |
| Industrial/Technical/ Scientific Opportunity: | Final report will be of value to operators of fishing vessels when determining the feasibility for operations in Arctic and Sub-Arctic regions. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Load Lines and Stability - Arctic Ships |
| Project Number: | 2049 |
| 1983/84 Expenditure: | $45,000 |
| Project Officer: | J. Grinstead, Coast Guard Northern Branch |
| Contractor: | Det Norske Veritas Canada Ltd. |
| Departmental Objective: | To provide CCG with timely information necessary to comply with the departmental mandate to attend to the provision of a safe and efficient transportation system. |
| Project Description: | A review will be undertaken of the application of the present criteria to Arctic Class vessels based on experience to date and any deficiencies in the criteria will be identified. Scenarios will be developed for possible situations which may be encountered by various types of vessels during Arctic navigation, depending on voyage classification i.e., short term, long term; cargo operations; patrol operations; SAR operations, etc. The current criteria shall be applied to the various scenarios developed and any deficiencies shall be identified. Proposals for revised criteria, if any, shall be developed. |
| Status: | Active |
| Reports/Deliverables: | TP 5374E - Load Line and Stability for Arctic Class Ships. |
| Industrial/Technical/ Scientific Opportunity: | Increased confidence for owners of vessels operating in the Arctic during the winter months. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Arctic Operations - Manning |
| Project Number: | 2051 |
| 1983/84 Expenditure: | $75,750 |
| Project Officer: | J. Daniels, Coast Guard Ship Safety Branch |
| Contractor: | Melville Marine Consultants |
| Departmental Objective: | To ascertain the effects of year round Arctic navigation on present rules and practices governing officer certification, manning and training in order to promote safe Arctic navigation. Also to define training objectives which may be adaptable to a ship handling simulator. |
| Project Description: | The objectives of the project are to conduct an R&D study establishing the factors and guidelines which should govern standards of manning, qualification, experience and training for shipboard personnel operating Arctic Class vessels under all conditions and to develop operationally oriented navigational practices and procedures in the same circumstances. |
| Status: | Active |
| Reports/Deliverables: | Interim reports and a final report upon completion of the study. |
| Industrial/Technical/ Scientific Opportunity: | Will be of interest to CCG Fleet Systems, Canarctic Shipping, Arctic Pilot Project, Dome, Gulf, Arctic Transportation Ltd., and Esso Resources Ltd. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Crew Accomodation on Arctic Class Ships |
| Project Number: | 2053 |
| 1983/84 Expenditure: | $38,000 |
| Project Officer: | J. Grinstead, Coast Guard Northern Branch |
| Contractor: | Melville Shipping Ltd. |
| Departmental Objective: | To provide CCG with the necessary background information to develop standards for the physical and psychological health of crews subjected to the Arctic environment. This is in compliance with the departmental objective to attend to the provision of a safe and efficient marine transportation system. |
| Project Description: | A study will be made of the facilities provided for crew health and welfare on existing vessels operating in the Arctic environment. Scenarios will be developed for similar activities assuming longer periods of exposure to the environment depending on the type of operation involved, i.e. vessels operating in a transit capacity in and out of the Arctic, vessels operating full time in the Arctic, etc. Deficiencies in facilities will be identified based on the scenarios developed and proposals for further action will be developed. |
| Status: | Active |
| Reports/Deliverables: | TP 5362E - Crew Accommodation on Arctic Class Ships. |
| Industrial/Technical/ Scientific Opportunity: | The results of this project will be of value to owners and operators of vessels proposing extended operations in the Arctic environment. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Survey, Repair and Salvage Techniques in the Arctic |
| Project Number: | 2054 |
| 1983/84 Expenditure: | $46,000 |
| Project Officer: | J. Grinstead, Coast Guard Northern Branch |
| Contractor: | Melville Shipping Ltd. |
| Departmental Objective: | To provide CCG with timely information necessary to comply with the departmental mandate to attend to the provision of a safe and efficient transportation system. |
| Project Description: | A study will be made of current practices in the field of surveys, repairs and salvage on a worldwide basis. Scenarios will be developed for similar activities in the Arctic environment, with particular emphasis on winter activities. Deficiencies in current methods and techniques will be identified and proposals for further action will be developed. |
| Status: | Active |
| Reports/Deliverables: | TP 5363E - Survey, Repair and Salvage Techniques in the Arctic. |
| Industrial/Technical/ Scientific Opportunity: | Increased confidence for owners of vessels operating in the Arctic during the winter months. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Frequency Agile Racons (FAR) |
| Project Number: | 2059 |
| 1983/84 Expenditure: | $50,000 |
| Project Officer: | E.T. Mullen, Coast Guard Aids & Waterways Branch |
| Contractor: | Vega Precision Laboratories |
| Departmental Objective: | To enhance the usefulness of shipboard radar as a prime aid to navigation in the Arctic. |
| Project Description: | The specific objective of this project is to have installed and fully oprational Canadian dealer supported frequency agile RACONS in the Arctic by mid-1986.<br><br>In 1981/82 a FAR from AGA Sweden was procured from Coast Guard R&D funds. This unit was verified for operational performance in Southern Canada.<br><br>In 1982/83 two additional European FARs were purchased. Due to the requirement for extensive testing, training and development of a special heated container, they will not be installed in the Arctic until 1983/84.<br><br>In 1983/84 a special low temperature RACON will be purchased and tested. |
| Status: | Active |
| Reports/Deliverables: | TP 4237 - Guidelines for determining and verifying operational requirements for racons. |
| Industrial/Technical/ Scientific Opportunity: | To promote safe and efficient navigation in Arctic waters by providing a nav-aid to complement on-board radar. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Communications Control Console |
| Project Number: | 2065 |
| 1983/84 Expenditure: | $400,000 |
| Project Officer: | B.M. Davies, Coast Guard Telecommunications and Electronics Branch |
| Contractor: | Jatel Communications |
| Departmental Objective: | N/A |
| Project Description: | The major objective of the project is to demonstrate that present day switching techniques, employing micro-processor technology, can be applied to meet existing and future operational requirements of Coast Guard radio stations. This objective will be achieved by:<br><br>a) Carrying out an engineering development that will result in the production of a functional engineering model of remote control communication switching system.<br><br>b) Assessing the capabilities of the developed system by conducting engineering and operational trials using the engineering model.<br><br>There have been no previous projects of this nature to attack the communications control problems being experienced at Coast Guard radio stations. |
| Status: | Active |
| Reports/Deliverables: | Final report upon completion of the study |
| Industrial/Technical/ Scientific Opportunity: | The development project will have primary regard for Canadian Coast Guard radio station requirements, which are at least as extensive as those of other government and private agencies requiring communications control facilities. The developed design in whole or in part, could find wide application and would also contribute to the expertise being accumulated in the Canadian high technology industry. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | MF/HF Antenna Measurements and Radio Propagation and Analysis in the Arctic |
| Project Number: | 2066 |
| 1983/84 Expenditure: | - |
| Project Officer: | B.M. Davies, Coast Guard Telecommunications and Electronics Branch |
| Contractor: | N/A |
| Departmental Objective: | N/A |
| Project Description: | Coast Guard radio stations at Frobisher Bay, Inuvik and Resolute Bay are most urgently in need of a study which will investigate the following major areas:<br>a) Actual communications coverage versus required coverage<br>b) Site location and layout<br>c) Technical suitability of existing antenna systems to provide required coverage<br>d) Possible technological improvements<br>e) Electrical condition and performance of existing antenna and ground systems.<br>f) Interaction between antenna<br>g) Ground conductivity<br>h) Lightning protection<br>i) Radio noise levels, interference, intermodulation<br>j) Establishing a performance base line against which future maintenance checks can be compared. |
| Status: | Completed |
| Reports/Deliverables: | Final Report available. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Engineering Design Study for Maritime Mobile Communications in the Canadian Arctic |
| Project Number: | 2067 |
| 1983/84 Expenditure: | - |
| Project Officer: | B.M. Davies, Coast Guard Telecommunications and Electronics Branch |
| Contractor: | Gauthier, Simard, Deschamps |
| Departmental Objective: | N/A |
| Project Description: | Subsoil investigations and topographical surveys will be carried out at various Arctic locations under the jurisdictions of the Laurentian Region and the Newfoundland Region. Pre-engineering investigations will also be carried out to evaluate the technical effectiveness of various system configuration alternatives. |
| Status: | The project is completed. |
| Reports/Deliverables: | The Newfoundland region used its allotted funds to perform, under contract, site surveys and soil tests at Cartwright, Hopedale and Goose Bay. Survey reports and site layout drawings for those sites were prepared.<br><br>The Laurentian Region awarded a contract to the firm Gauthier, Simard, Deschamps for an architectural design of a new Coast Guard operations building to be erected at Frobisher and possibly Resolute. The architects filed a report entitled "Batisse des Operations - Frobisher et Resolute". |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Arctic Lifesaving, Survival and Rescue |
| Project Number: | 2071 |
| 1983/84 Expenditure: | $102,000 |
| Project Officer: | M. Dempster, Coast Guard Ship Safety Branch |
| Contractor: | Melville Shipping Ltd. |
| Departmental Objective: | To set standards for lifeboat equipment which reflect modern technology and which are appropriate to the climatic conditions in which modern Canadian vessels operate. |
| Project Description: | The project will consist of employing an outside consultant to conduct a study resulting in a list of recommendations for changes to the regulatory requirements. The study will be divided into the following stages:<br>1) To prepare a detailed survey of existing equipment and supplies carried in lifeboats and liferafts in Canada and throughout the world.<br>2) An analysis to be made of past marine disasters where lifeboats have been used to determine if possible which equipment and supplies have been found to be of value and which were redundant.<br>3) An analysis to be made of the operational parameters in which lifeboats and liferafts are likely to be used on Canadian ships at the present time and in the foreseeable future.<br>4) A review is to be made of possible items of equipment and supplies, not currently in use for lifeboats and liferafts, which may nonetheless be of similar or greater value than currently required equipment. |
| Status: | Completed |
| Reports/Deliverables: | Final report available |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | R&D Project Management |
| Project Number: | 2079 |
| 1983/84 Expenditure: | $6,000 |
| Project Officer: | M. Dempster, Coast Guard Ship Safety Branch |
| Contractor: | Versatile Vickers Systems Inc. |
| Departmental Objective: | To undertake the necessary studies to develop regulations to ensure safe Arctic marine transportation. |
| Project Description: | To provide certain project management services for projects 2071A study on Synthetic Cordage, 2071B study of the Lifespan of Inflatable Liferafts and 2071C study of Lifeboat Equipment. |
| Status: | Active |
| Reports/Deliverables: | Final report upon completion of the study |
| Industrial/Technical/ Scientific Opportunity: | This project will increase the involvement of private industry with Arctic R&D. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Development of Arctic Power Supplies |
| Project Number: | 2080 |
| 1983/84 Expenditure: | $35,000 |
| Project Officer: | M.C. Armstrong, Coast Guard Aids & Waterways Branch |
| Contractor: | Technical support as required will be supplied by industry.<br><br>Wind generator purchased from North Wind Ltd., Vermont, U.S.A.<br><br>Solar photovoltaic system purchased from Lanbrook Industries, Scarborough. |
| Departmental Objective: | To standardize on a highly reliable solar and/or wind powered electrical generating system for minor aids to navigation in the Arctic. |
| Project Description: | The objective of the project is to have one solar powered RACON and one wind powered RACON operating in the Arctic on a year round basis by mid 1985.<br><br>The Arctic wind generator, presently under test at Cape Spencer, New Brunswick, has experienced several problems. While it would appear these problems have been, or are being resolved, we are delaying installation of the equipment in the Arctic until we feel the unit has exhibited the required reliability required by this project.<br><br>The solar photovoltaic system is scheduled to be installed in the Arctic in 1984. Its application is for powering a RACON 12 months a year. |
| Status: | Active |
| Reports/Deliverables: | Final report upon completion of study |
| Industrial/Technical/ Scientific Opportunity: | - |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Containerized Arctic Navigation Aid Unit |
| Project Number: | 2081 |
| 1983/84 Expenditure: | $8,000 |
| Project Officer: | M. Armstrong, Coast Guard Aids & Waterways Branch |
| Contractor: | Technical support is being provided by MECHRON Energy Ltd. |
| Departmental Objective: | To establish the feasibility of the containerized diesel cycle charge concept for aids and telecommunication application in the Arctic. |
| Project Description: | The diesel powered 'cycle charge system' has been transferred to our "Navigation Aids Test Establishment" (NATE) at East Cardinal, Ontario. It has been in operation at 'NATE' since May, 1983. Our original plan to transfer the unit to Griffith Island, Resolute in August, 1984 has not been changed. |
| Status: | Active |
| Reports/Deliverables: | Final report on completion of study. |
| Industrial/Technical/ Scientific Opportunity: | The development of a containerized "cycle-charge" Nav-Aid Power supply would provide a solution where both low wattage power and low consumption of fossil fuel is required at isolated communication or Nav-Aid sites. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Light-weight Semi-disposable, Air-deployable Boom Evaluation |
| Project Number: | 2082 |
| 1983/84 Expenditure: | - |
| Project Officer: | E. Gauthier, Coast Guard Emergencies Branch |
| Contractor: | S.L. Ross Environmental Research Ltd. |
| Departmental Objective: | Coast Guard Emergencies will attend to the minimization of environmental damage resulting from vessel source pollution. |
| Project Description: | The specific objective of this project is to attain a standardization in a light-weight oil containment boom which may be readily deployed to remote Arctic sites by light aircraft (i.e. Beaver, Otter, etc.) CCGE has presently acquired five representative type, all of which are less than one third the weight of our standard inshore boom. |
| Status: | Completed |
| Reports/Deliverables: | The Field Evaluation of Five Prototype Lightweight Booms. |
| Industrial/Technical/ Scientific Opportunity: | Significant interest has been shown for this lightweight semi-disposable boom both in Canada and internationally. Three main boom manufacturers are now producing this product in Canada. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Stirling Cycle Generator |
| Project Number: | 2093 |
| 1983/84 Expenditure: | $70,000 |
| Project Officer: | M. Armstrong, Coast Guard Aids & Waterways Branch |
| Contractor: | Orraids |
| Departmental Objective: | To establish the feasibility, reliability and energy consumption of the thermal electric (Stirling) engine as a power source for Aids and Telecommunications loads in the High Arctic. |
| Project Description: | Select a manufacturer for the Harwell Stirling TEG design engine. Manufacture and test prototypes. Contract a design study for a containerized Stirling engine/battery charging system operating on propane with full heat recovery. Contract the manufacture of the total system. Carry out evaluation in the Ottawa area for 12 months. Transfer the unit to the High Arctic for environmental testing. Investigate spin-offs for operational use in Southern Canada. |
| Status: | Active |
| Reports/Deliverables: | Final report to be submitted at completion of the study. |
| Industrial/Technical/ Scientific Opportunity: | Mission related equipment. Energy conservation. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Participation with Canmar in Ship/Ice Interaction |
| Project Number: | 2094 |
| 1983/84 Expenditure: | $530,000 |
| Project Officer: | J. Grinstead, Coast Guard Northern Branch |
| Contractor: | Canadian Marine Drilling Ltd. |
| Departmental Objective: | - updating ASPPR's<br>- promoting Arctic Marine Transportation Technology<br>- Energy Transportation R&D<br>- Coast Guard Ship Design |
| Project Description: | The objectives:<br><br>1. To establish the global force against time in collisions with heavy ice.<br><br>2. To establish the dynamic magnification of the force in terms of ship response.<br><br>3. To establish the effect of asymmetry of impacts in terms of ship response.<br><br>4. To establish the rigid body accelerations in these impacts.<br><br>Analytical models of Supplier 9 (Robert Lemeur) and KIGORIAK which take account of three dimensional effects and analysis techniques which allow for the determination of forcing function at bow during impacts. Frank close fit method will be used to determine added mass distribution. The results will be compared to existing empirical formulae.<br><br>Instrumentation to measure longitudinal stress, distribution and stress distribution at as many cross sections as needed for forcing function analysis. Also vertical vibratory and rigid body accelerations will be measured. Local stress measurements to overlap work in 1981 on KIGORIAK. |

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| Status: | Active |
| Reports/Deliverables: | TP5399E - Kigoriak and Robert Lemeur - Full Scale Ice Impact Tests 1983.<br>Final Report - Completion of Experiement, Design, Testing and Preliminary Data Analysis. |
| Industrial/Technical/ Scientific Opportunity: | The scientific opportunity is to carry out field tests developed from the combined experience of Coast Guard and Dome Canmar which, together with the M.V. ARCTIC work will, if successful, constitute a significant Canadian achievement. |

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| **Department:** | Transport Canada |
| **Component:** | Canadian Coast Guard |
| **Project Title:** | Research Study to Consider the Supply of Northern Fuel to a Polar Icebreaker |
| **Project Number:** | 2095 |
| **1983/84 Expenditure:** | $20,000 |
| **Project Officer:** | I.K. Leslie, Coast Guard Northern Branch |
| **Contractor:** | Arctec Canada Limited |
| **Departmental Objective:** | - Determine storage and transfer facilities now available or planned by industry in the Arctic.<br>- Assess the suitability of these locations as potential refueling bases for the Polar 8.<br>- Determine whether dedicated facilities will be required for the Polar icebreaker. |
| **Project Description:** | - The project will consist of assessing available infrastructure used by CCG, Dome Petroleum and others in the Arctic, and their potential for support of the Polar icebreaker. An assessment will be made of industry plans for facilities which will be available after 1988 when the Polar icebreaker will be in service.<br>- The deficiencies apparent will be assessed, and recommendations made for alternative means of meeting these deficiencies (i.e. new bases, expansion of existing facilities, etc.) |
| **Status:** | Completed |
| **Reports/Deliverables:** | Final report available - Study of the Required Fuel Infrastructure Required to Support Polar Icebreaker. |
| **Industrial/Technical/ Scientific Opportunity:** | N/A |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Study on the Operational Capability of Lifeboat Engines |
| Project Number: | 2096 |
| 1983/84 Expenditure: | $42,000 |
| Project Officer: | M. Dempster, Coast Guard Ship Safety Branch |
| Contractor: | Hawker Siddeley Projects<br>Burlington, Ontario |
| Departmental Objective: | To ensure that mandatory safety equipment carried on board Canadian vessels is suitable for the anticipated environment, insofar as is possible taking into account modern technological advances. |
| Project Description: | The project will consist of employing a consultant under a TIES contract to develop a work statement and supervise all work under the overall management of a Project Officer provided from within the Safety Branch of Coast Guard. The study itself will be divided into the following stages: |

1. Prepare a review of current technology for lifeboat engines on a world wide basis. Review to include such aspects as expected equipment operational capabilities, equipment costs, equipment availability, source of manufacture, and equipment durability.

2. An analysis to be completed on the conditions in which lifeboat engines must operate in the Canadian environment.

3. A review of items 1 & 3 to determine whether current technology is adequate to meet the needs in the Canadian environment.

4. Recommendations as to any further study and/or development required to ensure that lifeboat engines are adequate for their expected use in the Canadian environment with special reference to Northern latitudes.

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| **Status:** | Completed |
| **Reports/Deliverables:** | Final report available - Study on Operational Capability of Lifeboat engines. |
| **Industrial/Technical/ Scientific Opportunity:** | N/A |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Northwest Passage Communications Experiment |
| Project Number: | 2097 |
| 1983/84 Expenditure: | $17,000 |
| Project Officer: | D. Davies, Coast Guard Telecommunications and Electronics Branch |
| Contractor: | Communications Research Centre |
| Departmental Objective: | N/A |
| Project Description: | The main objectives of this project are to:<br>a) obtain point-to-point propagation data at 450-470 MHz;<br>b) obtain ship to shore propagation data at 150 MHz, at and beyond the optical horizon;<br>c) Demonstrate voice and data communications using low power shore repeaters. |
| Status: | Active |
| Reports/Deliverables: | Two final reports at the completion of the study.<br>CRC paper: VHF and VHF propagation in the Canadian high Arctic. |
| Industrial/Technical/ Scientific Opportunity: | The developed design in whole or in part, could find wide application in the Government Departments and oil companies in the Arctic and would also contribute to the expertise being accumulated in the Canadian high technology industry. It has primary regard for Canadian Coast Guard requirements. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Ice Crushing Strength Research |
| Project Number: | 2101 |
| 1983/84 Expenditure: | $46,000 |
| Project Officer: | T.P. Hodgson, Coast Guard Aids & Waterways Branch |
| Contractor: | Performance by Consultant Dr. Bernard Michel and company "ROCTEST". |
| Departmental Objective: | The research is in line with the Coast Guard objective of providing aids to navigation on the basis that ice crushing strengths are used to determine the magnitude of the major force used in lightpier design, and current design practice would be better served by actual field data rather than the arbitrary, perhaps conservative, values now used. |
| Project Description: | a) The objective of the research work is to develop a simple and effective test system to measure the "in situ" crushing strength of ice by using a portable apparatus capable of operating under Arctic conditions. The scope of the work includes the redesign, development of specification, and the fabrication of a prototype test system based on work done in 81/82 by the consultant for the Department. Work also includes the design and construction of a borehole temperature sensor. Thereafter, extensive testing of all apparatus will be performed in both a cold outdoor field environment and an indoor controlled cold room environment. The interpretation of initial results from these tests will likely lead to future years testing.<br><br>b) The consultant undertook an initial exploratory project for the Department in 1981/82 at a cost of $15,000. A pressuremeter loading system was built, pressure tests in ice boreholes were made in a lake near Quebec City and the results, analysis and recommendations appeared in a report by Dr. Michel. Copies of the report are |

available in CGAA-C/M. It is considered that this project should proceed on an R&D status to fully develop the potential of this testing system.

Status: Phase I completed.

The project will continue into fiscal year 85/86.

Reports/Deliverables: A report entitled "Development of a Field Technique to Measure the "In Situ" Crushing Strength of Ice" Phase II dated March 1983 is available.

Industrial/Technical/ Scientific Opportunity: Results of project could likely be published in various scientific journals.

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Development of Ice Failure Criteria for Application to Models of Structure/Ice Interaction |
| Project Number: | 2102 |
| 1983/84 Expenditure: | - |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | NRC Division Building Research and various consultants, (to be carried out under a MOU between Transport Canada and NRC) |
| Departmental Objective: | Development and support of:<br>a) Offshore structures in ice covered water<br>b) Arctic Marine Transportation<br>c) Transportation of Energy commodities<br>d) Arctic Marine Safety Regulation |
| Project Description: | a) Determination of mechanical properties of a wide range of samples of multi-year glacial ice.<br>b) Development of ice failure criteria for input into structure/ice interaction models. |
| Status: | Completed |
| Reports/Deliverables: | Final report available |
| Industrial/Technical/ Scientific Opportunity: | The test data will be made available to Canadian organization working in the field when requested. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Study of Speed/Power Loss of Vessels in Ice Infested Waters |
| Project Number: | 2104 |
| 1983/84 Expenditure: | $17,000 |
| Project Officer: | N.E. Eryuzlu, Coast Guard Aids and Waterways Branch |
| Contractor: | Work being done in house. |
| Departmental Objective: | To study vessel speed/power loss in ice infested waterways and develop safe design/operational criteria. |
| Project Description: | Vessel models will be used for testing in the navigation basin at the Hydraulics Research Centre of the CCG. |
| Status: | Active |
| Reports/Deliverables: | Final report at completion of the study. |
| Industrial/Technical/ Scientific Opportunity: | Related to future navigational developments in cold regions. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | MV Arctic Brittle Fracture Risk |
| Project Number: | 2109 (see also TDC project with same number) |
| 1983/84 Expenditure: | $4,000 |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Technical Research Centre of Finland (VTT) |
| Departmental Objective: | - Safety of Arctic Class Ships<br>- Arctic Marine R&D<br>- Structural Steel Standards for Arctic Class Ships. |
| Project Description: | This was a vitally important case not only for MV Arctic, but also for other Arctic class ships since there are as yet no structural steel requirements in the regulations. A decision to replace some or all the "A" grade steel on MV Arctic may cost the owners several million dollars. The actual replacement will take up about a month of the ship's time. Further field testing in 1983 with this ship by Coast Guard is dependent on a speedy resolution of the problem. |
| Status: | Complete. Report received. |
| Reports/Deliverables: | Brittle Fracture Risk Assessment of MV Arctic. Limited distribution in government in view of owners interests. |
| Industrial/Technical/ Scientific Opportunity: | This together with the DNV report has pointed the way to meaningful research directed towards a permanent solution of the structural steels problem on Arctic ships. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Trafficability Study MV Columbialand Voyage from Europe to Little Cornwallis Island - 1982 |
| Project Number: | 2111 |
| 1983/84 Expenditure: | - |
| Project Officer: | J.S. McCallum, Coast Guard Northern Branch |
| Contractor: | Martec Limited<br>Ocean Science & Engineering Consultants |
| Departmental Objective: | - Updating Arctic Shipping Pollution Prevention Regulations;<br>- Arctic Marine Transportation Technology;<br>- Transportation of Energy Commodities. |
| Project Description: | Beginning and ending in the area of the mean maximum ice berg limits for August and September, respectively, southeast of Cape Farewell, the most important part of the data collection was undertaken. This entailed the recording of all actions and supporting information related to the COLUMBIALAND's encounters with ice hazards identified as real or potential threats to the ship. Ice hazards included ice bergs, bergy bits, growlers, drifting strips of mixed multi-year and first-year ice, drifting multi-year floes, and ice edges considered to be distinct regional features as and when manoeuvered through. |
| Status: | Completed. |
| Reports/Deliverables: | 1982 Navigability Study - MV Columbialand. Distribution limited due to marginally sensitive information on operation of a foreign privately owned ship whose owners gave full co-operation. |
| Industrial/Technical/ Scientific Opportunity: | Martec gained excellent experience in this work. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Lifesaving Equipment for Arctic Ships |
| Project Number: | 2125 |
| 1983/84 Expenditure: | $73,000 |
| Project Officer: | J. Grinstead, Coast Guard Northern Branch |
| Contractor: | Melville Shipping Ltd. |
| Departmental Objective: | To set standards for lifesaving equipment and procedures for Arctic class ships for inclusion in the regulations made under AWPPA and CSA. |
| Project Description: | The intent of this project is to evaluate the type, quantity standard and performance specification of lifesaving equipment which will be suitable for fitting to vessels operating in Arctic waters and to develop proposals and recommendations where deficiencies and/or omissions are found. |
| Status: | Active under project no. 2071 in 84/85. |
| Reports/Deliverables: | TP 5361E - Lifesaving Equipment for Arctic Ships. |
| Industrial/Technical/ Scientific Opportunity: | Report will be made available to public and industry at large. Results will be of value to all companies involved in exploration and/or exploitation of Arctic resources employing the marine mode of transport. |

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| Department: | Transport Canada |
| Component: | Canadian Coast Guard |
| Project Title: | Lifesaving Equipment for Arctic Ships |
| Project Number: | 2129 |
| 1983/84 Expenditure: | $91K |
| Project Officer: | J. Grinstead, Coast Guard Northern Branch |
| Contractor: | Arctec Canada Limited |
| Departmental Objective: | To support the regulatory mission of CCG by providing information which will assist in the updating of the ASPPR's with respect to midship hull strength, and to the strength of propellers, rudders, nozzles, etc. |
| Project Description: | The work is divided into four tasks as follows:<br>(a) Theoretical study of factors affecting broken ice piece size, characterization of full scale data, characterization of ice piece size definition.<br>(b) Model test program; determination of trends in results.<br>(c) Comparison of full scale and model results.<br>(d) Analysis of scaling effects, etc. and report.<br>The M.V. Kigoriak and the M.V. Pierre Radisson will be vessels used for this purpose. |
| Status: | Active |
| Reports/Deliverables: | TP 5373E - Modelling the Broken Channel (Modelling of Broken Ice Around Icebreakers). |

Industrial/Technical/
Scientific Opportunity: The project is a logical extension of previous work in the field of ship/ice interaction and will be of value to future researchers as well as to the owners and operators of Arctic class vessels.

It is an opportunity for Canada to contribute to the world wide knowledge base in this area.

TRANSPORTATION DEVELOPMENT CENTRE (TDC)

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ice Induced Vibration Measurement and Excitation Modelling |
| Project Number: | 2003 |
| 1983/84 Expenditure: | - |
| Project Officer: | I.M. Bayly |
| Contractor: | Arctec Canada Ltd. (with Arctec Inc. - US) |
| Departmental Objective: | To obtain information and develop hypotheses which will contribute to design and regulation of ice going ships by:<br><br>a) measuring the form and magnitude of hull vibrations on board USCGC "Polar Sea" during January 1981 icebreaking trials, and<br><br>b) developing a mathematical model for the icebreaking forces which excite hull vibrations. |
| Project Description: | Special Canadian instrumentation has been installed in the USCG icebreaker "Polar Sea" and records made during a trial in heavy northern ice in January 1981. Other US instrumentation measures ice properties, ship's propulsion performance, etc. Prior calculations of the hull vibratory properties were made to optimize location of instruments, subsequent further analysis will determine the modes of vibration experienced and will be used to develop a model for the excitation forces. |
| Status: | Complete |
| Reports/Deliverables: | Several volumes of reports dealing with environmental conditions, ship performance, etc. including one (with two appendices) dealing with vibration measurement and analysis, have been delivered. |

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| Industrial/Technical/ Scientific Opportunity: | Detailed and specific information about Arctic conditions and ship performance therein is scarce and valuable for future designs, regulations, economic studies, etc. Experience in preparing for and conducting icebreaking tests, analyzing results, etc. gives an important advantage in marketing and executing future work of a similar nature. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Steering System Ice Loads Full Scale Analysis and Measurement, Polar Star 1982 |
| Project Number: | 2004 |
| 1983/84 Expenditure: | - |
| Project Officer: | I.M. Bayly |
| Contractor: | Arctec Canada Ltd. (with Arctec Inc. US) |
| Departmental Objective: | To improve the safety, reliability and economy of marine traffic in arctic ice, by ascertaining effective steering system design criteria. |
| Project Description: | Some existing Canadian and U.S. records of full scale ice loads on steering systems will be reduced and analyzed, also new data which will be obtained during the coming USCGC "Polar Star" expedition. Instrumentation of the steering system will be designed, installed, and operated during an Arctic expedition. This was a jointly sponsored and executed project. |
| Status: | Complete |
| Reports/Deliverables: | Several volumes of reports have been delivered dealing with environmental conditions, ship performance, etc. including one (with appendices) dealing with loads in the steering system caused by ice. |
| Industrial/Technical/ Scientific Opportunity: | Detailed and specific information about Arctic conditions and the performance of ships and equipment therein is scarce and valuable for future designs, regulations, economic studies, etc. Experience in the preparing for, executing, analyzing and reporting of such field tests etc. gives an advantage in marketing and carrying out future work of a similar nature. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ice Load & Response Criteria, POLAR SEA 1983 |
| Project Number: | 2005 |
| 1983/84 Expenditure: | $169,874 |
| Project Officer: | I.M. Bayly |
| Contractor: | Arctec Canada Ltd. (with US Arctec Inc.) |
| Departmental Objective: | To facilitate marine access to Arctic resources with minimum risk to safety and environmental pollution:<br><br>a) by measuring and analyzing ice loads and hull structural response under a variety of well defined ice conditions to provide a basis for development of criteria for design and regulation of hull structures of ice-going ships.<br><br>b) by continuing participation in the series of data gathering expeditions being carried out by US Coast Guard "Polar" Class Icebreakers, obtaining ship performance and environmental data. |
| Project Description: | An extensive instrumentation system will be installed aboard the ship to measure various parameters in sufficient detail to determine ice loads, rigid body ice forces and ship responses, propulsion performance, etc., ice conditions will also be recorded in detail. Analysis of the data will present the results in a form readily useable by designers and potential operators of marine transportation system and offshore structures. This a joint Canada/US project. |
| Status: | Active |
| Reports/Deliverables: | Several volumes of reports will be delivered, dealing with environmental conditions, ship performance, etc. including one (with two appendices) dealing with loads exerted in the hull of ice contacts on the instrumented area. Reports will have distribution restricted for some time. |

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| Industrial/Technical/ Scientific Opportunity: | Detailed and specific information about Arctic conditions and the performance of ships and equipment therein is scarce and valuable for future designs, regulations, economic studies, etc. Experience in preparing for, executing, analyzing and reporting of such field tests, etc. gives an advantage in marketing and carrying out future work of a similar nature. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | MV Arctic Data: Dedicated Analysis |
| Project Number: | 2014 |
| 1983/84 Expenditure: | $96,001 |
| Project Officer: | R. Bertrand |
| Contractor: | Melville Shipping Ltd.; Fenco Consultants Ltd; Pierce Operational Dynamics Inc. |
| Departmental Objective: | To improve knowledge concerning ship performance in ice for the benefit of Canadian ship designers, builders, operators and regulatory authorities. |
| Project Description: | To undertake detailed analysis of recorded data obtained through the provision of permanently installed instrumentation aboard the MV Arctic and collected during the voyaging of the vessel in ice, and to make analysis responsive to the needs of identified users. |
| Status: | Active |
| Reports/Deliverables: | Contracting Packages for five main data analysis projects. Copy-sets of MV Arctic data tapes and videotapes recorded 1979 to 1981 Master Data Package including sensor status report (German and Milne Inc.); Ice load determination report (Fenco Consultants Ltd.); Special report on Lake Melville Probe (Melville Shipping Ltd). |
| Industrial/Technical/ Scientific Opportunity: | An advancement is being made in the development of ship borne instrumentation systems (including navigational aids) and the potential for ship handling simulators. A long term outcome of the expertise with the MV Arctic and the data being assembled will contribute to the development of optimization criteria for the overall design of Arctic class ships and onboard equipment leading to lower cost for equivalent operational capabilities or enhanced capabilities. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | MV Arctic Bow Redesign Study |
| Project Number: | 2017 |
| 1983/84 Expenditure: | $174,213 |
| Project Officer: | R. S. Nishizaki |
| Contractor: | Melville Shipping Ltd. |
| Departmental Objective: | To improve knowledge concerning ship performance in ice for the benefit of Canadian ship designers, builders, operators and regulatory authorities. |
| Project Description: | To undertake analyses and tests in order to redesign the MV Arctic bow shape and determine the economic benefits. |
| Status: | Active |
| Reports/Deliverables: | Technical reports covering all aspects of the test and analyses carried out. |
| Industrial/Technical/ Scientific Opportunity: | The results of the work will assist in the optimization of the design of Arctic-class cargo ships in order to achieve commercial benefits such as lower operating costs and extra trips. Also the data will assist regulatory authorities in updating powering requirements of C.A.S.P.P. regulations. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Semi-Empirical Ice Resistance Models Based on Full Scale Test |
| Project Number: | 2024 |
| 1983/84 Expenditure: | - |
| Project Officer: | I.M. Bayly |
| Contractor: | Arctec Canada Ltd. (with US Arctec Inc.) |
| Departmental Objective: | To be able to predict the resistance of a ship in ice. |
| Project Description: | A significant amount of ice resistance data is accessible in the form of results of several full scale ice performance trials, and a number of model tests. The material will be assembled, reduced to common format, and analyzed to provide the best available basis and methods for predicting power requirements. No new testing is included in this project but incorporation of new results as they become available in future will increase precision and reliability. This is a Canadian/US jointly sponsored and executed project. |
| Status: | Completed |
| Reports/Deliverables: | A computer program for calculating the resistance of any conventional icebreaking hull form, plus reports describing its composition and working, and assessing its performance against known cases. Distribution is restricted. |
| Industrial/Technical/ Scientific Opportunity: | The computer model is a useful tool for early prediction of icebreaking resistance of a hull form and for testing form variations for icebreaking effectiveness. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ship Structural Response Model |
| Project Number: | 2025 |
| 1983/84 Expenditure: | - |
| Project Officer: | R. Nishizaki |
| Contractor: | Melville Shipping Ltd. |
| Departmental Objective: | To improve the safety of Arctic Marine vessels. To upgrate the structural requirements of CASPPR. |
| Project Description: | To develop an analytical model to calculate the dynamic response of ship structure under arbitrary bow loads and to predict the bow forces causing the response using available test results from MV Arctic operation. |
| Status: | Completed |
| Reports/Deliverables: | TP 4191E. "Development of a Prediction Model for Dynamic Response and Bow Loading of Ships". |
| Industrial/Technical/ Scientific Opportunity: | Analytical expertise transferred from Finland to Canada to reduce the need to go offshore and thus create employment potential. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ice Class Propellers |
| Project Number: | 2027 |
| 1983/84 Expenditure: | - |
| Project Officer: | I.M. Bayly |
| Contractors: | Canadian Marine Drilling Ltd. (CANMAR)<br>Martec Ltd. |
| Departmental Objective: | To provide a scientific engineering basis to enable safe and effective design and regulation of marine propellers, shafts, etc. for arctic service. |
| Project Description: | This project consists of two separate contracts:<br>a) the icebreaking supply vessel "Robert Lemeur" had one blade instrumented during testing in the Beaufort Sea. Strains were recorded. Observed impact were related to the ice conditions.<br>b) a finite element model was developed to analyze stress patterns, levels and material failure modes in the propeller blades. |
| Status: | The FEM contract is complete while the blade instrumentation contract is still active. |
| Reports/Deliverables: | a) Reports indicating the effect of stresses on a number of possible variations in propeller diameter, assuming a simple load distribution.<br>b) Reports including details of instrumentation system, analysis procedures and forces measured along with related environmental conditions. |
| Industrial/Technical/ Scientific Opportunity: | Detailed and specific information about Arctic conditions and the performance of ships and equipment therein is scarce and valuable for future design, regulatory purposes and economic studies. |

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| **Department:** | Transport Canada |
| **Component:** | Transportation Development Centre |
| **Project Title:** | Protection of Propellers in Ice |
| **Project Number:** | 2029 |
| **1983/84 Expenditure:** | - |
| **Project Officer:** | N.R. Gore |
| **Contractor:** | Davis Engineering Ltd., Ottawa |
| **Departmental Objective:** | To develop a method of protecting propellers of ice Class vessels from contact with large pieces of ice. |
| **Project Description:** | Existing vessels designed to operate in ice and conforming to C.S. 1 regulations have unprotected propellers. These ice strengthened propellers allow random contact with the ice, a practice known as "ice milling". The foregoing describes the state-of-the-art, and although mission are successfully accomplished by our icebreakers, there exists an ongoing maintenance effort because of propeller damage.<br><br>The maximum S.H.P./Shaft on our icebreakers is 9,000, but we are now considering up to 50,000 SHP/Shaft for icebreakers and icebreaking merchant vessels. This step will require very large and very expensive ($2M) propellers which are not economically suited to "ice milling". Some method will have to be found to protect these propellers from heavy ice. |
| **Status:** | Completed |
| **Reports/Deliverables:** | Final report is available |
| **Industrial/Technical/ Scientific Opportunity:** | This project has the propellers in tunnels protected by grids. If successful the propellers and shafting can be rated Class 2 instead of Class 10. This means that propeller weight reduces from approximately 120 tons to 40 tons and the shafting from 5 feet (1.5M) to 34" (0.84M). The foregoing represents a very large saving in construction costs, and ultimately in maintenance, resulting from propeller damage in heavy ice. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ship Heat Flow Model |
| Project Number: | 2039 |
| 1983/84 Expenditure: | - |
| Project Officer: | I.M. Bayly |
| Contractor: | H.G. Engineering Ltd. |
| Departmental Objective: | To support effective design of ship structures against brittle cracking during Arctic operations by providing a means of assessing the temperatures of structral components. |
| Project Description: | Instrumentation was installed on MV Arctic and readings taken during a voyage in Arctic waters. Results were analyzed and applied to verifying a mathematical heat flow computer model developed under a previous contract. |
| Status: | Completed |
| Reports/Deliverables: | Results incorporated in report of modelling study. |
| Industrial/Technical/ Scientific Opportunity: | Experience in shipboard temperature measurement is applicable to future work. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Externally Pressurized Stern Tube Bearings |
| Project Number: | 2040 |
| 1983/84 Expenditure: | $111,492 |
| Project Officer: | N.R. Gore |
| Contractor: | Peacock Inc., c/o Naval Engineering Test Establishment |
| Departmental Objective: | To improve the reliability and safety of ships operating in the Arctic, through improved stern tube bearing performance. |
| Project Description: | To manufacture and test a 1/5 scale hydrostatic stern tube bearing, and test it in the laboratory under simulated service conditions. The testing includes vibratory and eccentric thrust effects. If found satisfactory, a demonstration bearing will be installed in a CCG ship. |
| Status: | Completed |
| Reports/Deliverables: | Final report under preparation. |
| Industrial/Technical/ Scientific Opportunity: | Wear down and destruction of conventional hydrodynamic stern tube bearings is on the increase, because of insufficient hydrodynamic film to support the very heavy propeller/screw shaft assemblies of modern large cargo carrier. The hydrostatic or externally pressurized bearing offers a solution to this costly problem (about $100M per year). In such a bearing the shaft is not supported by hydrodynamic film, but rather has the journal pressurized clear of the bearing at all times. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Wave Climate - Documentation Study |
| Project Number: | 2046 |
| 1983/84 Expenditure: | - |
| Project Officer: | E.T. Fisher |
| Contractor: | W.F. Baird and Associates, Coastal Engineers |
| Departmental Objective: | To ensure the continuity of adequate Canadian structural strength standards for ships and other floating structures by detailed consideration of the marine environment, and: to develop a Canadian methodology for relating wind and wave climatology in Arctic and offshore maritime regions of Canada to structural design criteria for ships and other floating structures. |
| Project Description: | - |
| Status: | Completed |
| Reports/Deliverables: | Wave Climate Documentation Study - Final Report TP 3868 published, Summary Reports in French and English in final process. |
| Industrial/Technical/ Scientific Opportunity: | The content of the report provided the background for a wave climate Study of coastal waters of the East Coast of North America out to 200 miles offshore. This in turn enabled strength assessment studies to be made of a Canadian ship proposing to use this trade route. The ability to assess wave climate by the best available methods and apply these to ship design criteria is of importance for regulatory purposes and to the future of shipbuilding. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ice Hazard Detection/Collision Avoidance |
| Project Number: | 2057 |
| 1983/84 Expenditure: | $118,948 |
| Project Officer: | M. Audette |
| Contractor: | Viatec Resource Systems Inc. (4821), Nordco Ltd. (4865) |
| Departmental Objective: | To develop a ship-mounted and computer controlled ice hazard detection/collision avoidance system for more efficient and safer marine transportation in ice infested Arctic and Northern waters. |
| Project Description: | To refine the system specification for an ice hazard detection and collision avoidance system, to investigate on the options available, and to make a preliminary assessment of the sea trials data currently available from Petro-Canada on the Polarhav trials, to gather information and assess on-going R&D on relevant sub-systems and to formulate specific recommendations for additional R&D where needed. |
| Status: | Completed |
| Reports/Deliverables: | Nordco TP 4435E - Detection and Avoidance of Hazardous Ice Conditions at Sea - A Review of R&D Activities in Canada.<br><br>Viatec TP 4897 - Specification Investigation and Data Assessment of an Ice Hazard Detection/Collision Avoidance System. |
| Industrial/Technical/ Scientific Opportunity: | An advancement is being made in the development of a shipborne ice hazard and collision avoidance system. The new knowledge being gathered on ice/radar detection characteristics should permit a better definition of the radar requirements and thus achieve better system performance. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Sea Ice Thickness Sensing System |
| Project Number: | 2058 |
| 1983/84 Expenditure: | $202,450 |
| Project Officer: | M. Audette, |
| Contractor: | MBP Technologies/Polar Tech |
| Departmental Objective: | To improve the safety and efficiency of transportation in ice infested waters through the development of effective sea-ice thickness measuring sensors. |
| Project Description: | A) To test the overall prototype sea-ice thickness sensor design, electronics and antenna, in a near operational environment, and to identify the modifications needed to prepare the prototype sensor for Arctic trials.<br><br>B) To develop a laboratory model of a portable hand carried ice thickness measuring device, which would accurately and quickly measure ice thickness irrespective of the ice's properties. |
| Status: | Active |
| Reports/Deliverables: | Reports will be available at completion of the project. |
| Industrial/Technical Scientific Opportunity: | Advancements are being made in the development of both an airborne and a portable ice thickness sensor. Earlier field trials yielded encouraging results and the helicopter borne sensor is nearing the operational prototype stage. Preliminary field test with an experimental portable sensor have also given valid results and should yield an effective sensor. When both sensor developments will be completed, the measurement of ice thickness will be much easier and operations in ice infested water safer. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Investigative Study of Simulation Techniques and Navigation Problems for the Arctic Marine Environment |
| Project Number: | 2064 |
| 1983/84 Expenditure: | $70,081 |
| Project Officer: | R. Bertrand |
| Contractor: | Arctec Canada Ltd. |
| Departmental Objective: | Develop a ship/ice interaction and manoeuvering simulator capability, and for conducting research into Canadian marine navigation problems in ice covered waters. |
| Project Description: | Undertake investigative studies to determine the current state of the art and the additional development required to bring simulation techniques to bear on Arctic navigation problems and to assist TDC in establishing a long term R&D program in this field. |
| Status: | Project completed |
| Reports/Deliverables: | The report has advanced the understanding of what is required to achieve a capability of simulating ships manoeuvering in ice covered waters and for research into navigation problems in general. A program of development, to a full operating ice capability simulator facility, is given. This includes the acquisition required of data from which software programs can be devised. Hardware procurement and costs are proposed. The capability could be a world first on which Canada could offer training in navigating in ice, and research into Arctic marine problems. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Air Cushion Icebreaking Bow (ACIB) Evaluation |
| Project Number: | 2070 |
| 1983/84 Expenditure: | $131,647 |
| Project Officer: | J.E. Laframboise |
| Contractor: | German and Milne |
| Departmental Objective: | To improve overall effectiveness of icebreaking operation in inland and coastal waters through the development of an Air Cushion Icebreaking Bow (ACIB), and to extend ACIB technology for applications in the Arctic. |
| Project Description: | To prepare the ACIB for operations at Thunder Bay by carrying out essential repairs and modifications, set-up a maintenance base and provide personnel to maintain the craft and to collect operating data, during its use by Coast Guard on icebreaking duty during the 1982/83 winter season. |
| Status: | Completed |
| Reports/Deliverables: | TP 4446E, "Air Cushion Icebreaking Bow (ACIB) Trials Reports 1983/84"<br><br>TP 5497E, "Air Cushion Icebreaking Bow (ACIB) Operations Report 1983/84". |
| Industrial/Technical/ Scientific Opportunity: | The multifold improvement in icebreaking performance obtained with an ACIB over conventional icebreakers, provide canadian industry with a sizeable advance over the competition. Lessons learned through the ACIB experience can be applied to further scientific developments in icebreaking technology. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Maintenance of Arctic Ports and Harbours |
| Project Number: | 2072 |
| 1983/84 Expenditure: | - |
| Project Officer: | Dr. L. McCoomb |
| Contractor: | Acres Consulting Services Ltd. |
| Departmental Objective: | To extend the Arctic shipping season by eliminating the ice barriers which form in Arctic port and harbour. |
| Project Description: | To identify and evaluate the complete range of ice control techniques for Arctic harbours. The engineering design manual for Arctic port ice management. |
| Status: | Complete |
| Reports/Deliverables: | Ice Control for Arctic Ports and Harbours Summary Report - TP 4156E<br>Ice Control for Arctic Ports and Harbours Final Report, Vols I and II, TP 3967E |
| Industrial/Technical/ Scientific Opportunity: | New concepts for port ice management have been developed as a result of this study and an important consolidated engineering design manual assembled which will help Arctic port designers match an ice management techniques to their particular problem. |

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|---|---|
| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Construction Guidelines for Arctic Ports, Ports Design Handbook |
| Project Number: | 2073 |
| 1983/84 Expenditure: | $53,000 |
| Project Officer: | D.W. Dibble |
| Departmental Objective: | To prepare construction standards for Arctic port facilities and navigational aids. |
| Project Description: | Design guidelines for Arctic port installations and navigational aids will be established by reviewing the current literature and the actual experience in Arctic ports. Problem areas will be identified and construction guidelines and practices recommended to overcome those based on sound engineering experience. Where gaps exist in current knowledge and experience experimental programs will be recommended to determine appropriate standards. |
| Status: | Completed |
| Reports/Deliverables: | Final Report currently available. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

| | |
|---|---|
| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | M/V Arctic - Evaluation of Steel Grades |
| Project Number: | 2109 (see also CG project with same number) |
| 1983/84 Expenditure: | $4,000 |
| Project Officer: | A.A. Hope |
| Contractor: | Det Norske Veritas (A Ship Classification Society) |
| Departmental Objective: | To improve the overall performance of ice classed ships for navigation in ice and on the open seas. |
| Project Description: | To conduct a quantitative evaluation of the steel grades used in the construction of the MV Arctic, in relation to the vessels operating environment. Assess the risks of brittle fracture and if confirmed make recommendations that would reduce the probability of hull failure. |
| Status: | Completed. |
| Reports/Deliverables: | The report demonstrates that when various implicit assumptions are made, the recommended changes to the ships ballast distribution, and the steel grade used in the bilge strakes, and in the deck plating, can significantly reduce the risk levels of hull failure. The report reveals that the higher hull girder bending moments result from operations in the open Atlantic Ocean, rather than as a result of ramming heavy ice in Arctic waters. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

| | |
|---|---|
| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Fuelling - Polar Sea (Spring 1983) |
| Project Number: | 2112 |
| 1983/84 Expenditure: | - |
| Project Officer: | I.M. Bayly |
| Contractor: | U.S. Coast Guard |
| Departmental Objective: | To facilitate marine access to Arctic resources with minimum risk to safety and environmental pollution. |
| Project Description: | Arrangements were made for fuel to be delivered to a US Coast Guard ship at a Canadian port, in order to extend the amount of ship activity possible during the Winter 1983 expedition of USCGC "Polar Sea" in which Transport Canada also participated in scientific work carried out. |
| Status: | Complete |
| Reports/Deliverables: | A full testing program was carried out in the North Churchill Sea (near Point Barrow), data gathered is reported under Polar Class projects. |
| Industrial/Technical/ Scientific Opportunity: | Opportunities arise through the data gathering parts of the project. |

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|---|---|
| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ultrasonic Doppler Velocimeter |
| Project Number: | 2113 |
| 1983/84 Expenditure: | - |
| Project Officer: | R.S. Nishizaki |
| Contractor: | GENTEC Inc. |
| Departmental Objective: | To improve knowledge concerning ship performance in ice for the benefit of Canadian ship designers, builders, operators and regulatory authorities. |
| Project Description: | To develop an ultrasonic doppler velocimeter for icebreaker application and capable of providing highly accurate speed indication at extremely low speeds. |
| Status: | Active |
| Reports/Deliverables: | Prototype Velocimeter and report. |
| Industrial/Technical/ Scientific Opportunity: | There is a need for an accurate onboard velocimeter to record speed during icebreaking trials. Potential exists for international sales of another product line by the contractor who previously developed a successful optical laser to measure length and speed. |

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| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Navigation Aid Warning System (NAWS), Hull Stress Level Warning System |
| Project Number: | 2115 |
| 1983/84 Expenditure: | $59,119 |
| Project Officer: | M. Audette |
| Contractor: | German and Milne Inc. |
| Departmental Objective: | To improve the safety of ships navigation in ice. |
| Project Description: | To develop from concept to preproduction model the instrumentation for a navigation aid warning system (NAWS) to measure structural strains caused by ice impacts. The development includes ship testing of breadboard model and operational evaluation. The preproduction model is to be installed aboard CCG ship Pierre Radisson in 1983. |
| Status: | Completed |
| Reports/Deliverables: | Final report available |
| Industrial/Technical/ Scientific Opportunity: | Advancement is being made in the development and shipborne deployment of a unique navigation aid warning system. |

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|---|---|
| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Concepts for Marine Arctic Survival Capsule |
| Project Number: | 2116 |
| 1983/84 Expenditure: | $133. |
| Project Officer: | M. Avni |
| Contractor: | Bert Van Leeuwen Industrial Design Ltd. |
| Departmental Objective: | To improve safety of marine transportation in Canada's Coastal and Arctic waters. |
| Project Description: | To develop conceptual design and specifications for three types of a marine survival capsule. |
| Status: | Completed |
| Reports/Deliverables: | Final technical report available<br><br>TP 4438E - "Concepts for Marine Survival Capsule". |
| Industrial/Technical/ Scientific Opportunity: | The need for marine survival equipment in the cold waters off the coast of Canada is well recognized. This conceptual evaluation will permit specific decision regarding future development of a survival capsule or an alternate concept to be followed. |

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|---|---|
| Department: | Transport Canada |
| Component: | Transportation Development Centre |
| Project Title: | Ice Loads on a Fishing Vessel Hull |
| Project Number: | 2131 |
| 1983/84 Expenditure: | $30,000 |
| Project Officer: | I.M. Bayly |
| Contractor: | Fisheries Resource Development Ltd. (Prime)<br>Arctec Canada Ltd. (subcontractor) |
| Departmental Objective: | To facilitate access to northern fish stocks by developing hull structure design and regulatory criteria for fishing vessels operating in ice off Labrador. |
| Project Description: | 1. To measure, record and analyse ice induced loads and hull structural response on a fishing vessel operating in ice.<br><br>2. To deduce representative ice impact load configurations and magnitudes appropriate for application as hull structural design criteria for the area, type of vessel, and operation. Fishing vessel ice damage reports were reviewed and strain guage locations optimized by finite element analyses of the hull structure involved. Instrumentation was installed and operated on the National Sea Products Ship Cape Briar during one fishing voyage involving floating ice and the recorded results analysed to determine ice impact loads. |
| Status: | This project is completed but further work in the area is anticipated. Drafting of regulations was not attempted during this project. |
| Reports/Deliverables: | TP 6046E, TP 6045 - "Measurement of Ice Forces on Fishing Vessels". |

Industrial/Technical/
Scientific Opportunity: This work indicated that potentially hazardous loads may be experienced by fishing vessels at some time in their lifespan. The work will improve design procedures for fishing vessels and other vessels operating in similar ice conditions. This is the first time this kind of work has been carried out on fishing vessels.

CANARCTIC SHIPPING LTD.

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|---|---|
| Department: | Transport Canada |
| Component: | Canarctic Shipping Ltd. |
| Project Title: | Re-Arrangement of Ballast Water to Reduce Still Water Bending Moment on MV Arctic |
| Project Number: | 2020 |
| 1983/84 Expenditure: | - |
| Project Officer: | M. Luce |
| Contractor: | Intercan Logistical Services |
| Departmental Objective: | To investigate methods of preventing still water bending moment during ship operations in ice. |
| Project Description: | The modifications required to distribute ballast water in the MV Arctic's holds were considered, implemented and evaluated. |
| Status: | Completed |
| Reports/Deliverables: | Feasibility study and detailed procedures for modifications. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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|---|---|
| Department: | Transport Canada |
| Component: | Canarctic Shipping Ltd. |
| Project Title: | Improvements in Ice Navigation in Darkness |
| Project Number: | 2021 |
| 1983/84 Expenditure: | $268,000 |
| Project Officer: | M. Luce |
| Contractor: | J.M. Robson and National Research Council |
| Departmental Objective: | To improve safety when navigating in ice infested waters during darkness. |
| Project Description: | Several initiatives were carried out aboard the M.V. Arctic during the 1983 season in the field of ice hazard avoidance, particulary during periods of restricted visibility and/or darkness. The techniques used are being evaluated for their ability to provide ice interpretation, classification and forecasting as a basis for ship route selection through an ice field. |
| Status: | This work is complete. However, related work involving use of SAR/SLAR down links and a Shipboard Ice Navigation Support System (SINSS) is being conducted. |
| Reports/Deliverables: | Specifications and Evaluation of a Strategic Ice Navigation System. |
| Industrial/Technical Scientific Opportunity: | Successful testing of equipment could lead to the development of commercial markets. |

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|---|---|
| Department: | Transport Canada |
| Component: | Canarctic Shipping Ltd. |
| Project Title: | MV Arctic Ice Regime Studies |
| Project Number: | 2022 |
| 1983/84 Expenditure: | - |
| Project Officer: | M. Luce |
| Contractor: | Polar Research and Engineering<br>M. Robson |
| Departmental Objective: | To classify ice conditions such that full scale ice operations testing may be conducted in suitable conditions, and to provide data related to ship routing and trafficability in the Arctic. |
| Project Description: | Ice Regime Studies were carried out at the following places and times;<br>- Northern Baffin pack (June & July)<br>- Lancaster Sound (Oct., Nov., & Dec.)<br>- Cornwallis Island (June to Nov.) |
| Status: | This portion of the work is completed. However, related work involving ice regimes in different locations and times of year is continuing. |
| Reports/Deliverables: | Reports submitted by contractors |
| Industrial/Technical Scientific Opportunity: | Data obtained may be used to some extent by industry to select compromise routes. Data may also be used by other Arctic transportation projects to identify suitable testing conditions. |

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|---|---|
| Department: | Transport Canada |
| Component: | Canarctic Shipping Ltd. |
| Project Title: | MV Arctic Contingency |
| Project Number: | 2075 |
| 1983/84 Expenditure: | N/A |
| Project Officer: | M. Luce |
| Contractor: | N/A |
| Departmental Objective: | N/A |
| Project Description: | CANARCTIC's management fees for the research projects it managed on behalf of the Marine Administration were paid as agreed in Memorandum of Understanding between CMTA and the company. |
| Status: | Completed |
| Reports/Deliverables: | N/A |
| Industrial/Technical/ Scientific Opportunity: | N/A |

MARINE PLANNING AND FINANCE

(DMPF/CMRD)

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|---|---|
| Department: | Transport Canada |
| Component: | Marine Planning and Finance (DMPF) |
| Project Title: | Update of Arctic Research Program |
| Project Number: | 2103 |
| 1983/85 Expenditure: | - |
| Project Officer: | W. Ellwood |
| Contractor: | Arctec Canada Limited |
| Departmental Objective: | To improve effectiveness and safety of Arctic marine transportation |
| Project Description: | The original Arctic Research Program study was compiled by Arctec Canada in 1979. Since that time there have been significant developments in many of the areas covered in the report. This study updated these and assessed the extent that new developments have contributed to closing gaps in knowledge and identifying new directions for research. |
| Status: | Completed |
| Reports/Deliverables: | Final report completed and available. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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|---|---|
| Department: | Transport Canada |
| Component: | Marine Planning and Finance (DMPF) |
| Project Title: | Canada/Japan R&D Cooperation: Project Studies |
| Project Number: | 2105 |
| 1983/84 Expenditure: | $43,000 |
| Project Officer: | W. Ellwood |
| Contractor: | Arctec Canada Limited |
| Departmental Objective: | To establish a 'matrix' of international knowledge, facilities and capabilities in marine related technology. |
| Project Description: | To examine the expertise of the listed countries (USA, Japan, UK, France, USSR, F.R.G., Norway, Sweden, Finland, Denmark, Netherlands, New Zealand) under a variety of interest areas, and to assess relative Canadian capabilities. The matrix will provide a useful tool for identifying areas for participation in international ventures. |
| Status: | Matrix is complete. Final report available. Further work with respect to bilateral cooperation is taking place under this project area. |
| Reports/Deliverables: | Matrix as specified. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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|---|---|
| Department: | Transport Canada |
| Component: | Marine Planning and Finance (DMPF) |
| Project Title: | Arctic Marine R&D Program Evaluation |
| Project Number: | 2107 |
| 1983/84 Expenditure: | $68,000 |
| Project Officer: | W. Ellwood |
| Contractor: | Bureau of Management Consulting (BMC) |
| Departmental Objective: | The Arctic is one of TC's leading priorities. The need to update regulations and to find new ways to provide basic services essential to safe year-round navigation is paramount within CMTA. A program of Arctic Marine R&D is the focal point of the Administration's current and future R&D program. |
| Project Description: | This project involved the preparation of an "evaluation/assessment" and an actual evaluation of Phase I of the Arctic Marine R&D Program 1981/82 - 1983/84, along with a background paper which reviews developments in areas related to the program - i.e. level of activity in the North, current government priorities, world energy outlook etc. |
| Status: | The assessment and evaluation of Phase I is complete, but further work is being undertaken with respect to the evaluation of Phase II (1984/84 - 1985/86). |
| Reports/Deliverables: | Final report on the evaluation. Final report for the submission to Treasury Board. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

FISHERIES AND OCEANS (DFO)

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|---|---|
| Department: | Fisheries and Oceans |
| Project Title: | Arctic Sea Ice Studies |
| Project Number: | 67125 |
| 1983/84 Expenditure: | $529,100 |
| Project Officer: | Dr. R. Lake - 10S, Pacific Region |
| Contractor: | - |
| Departmental Objective: | To investigate sea ice and ocean currents in Arctic Shipping Corridors. |
| Project Description: | This project comprises two distinct areas of investigation of one of the major Arctic channels to determine marine currents and their correlation with weather patterns over the Arctic Ocean. This project has expanded upon a small base program already in existence at the Institute of Ocean Sciences (IOS), OSS Pacific Region.<br><br>The second phase, also sponsored by IOS, consists of the establishment of one or two prototype acoustic sensor stations for the continuous monitoring of ice thickness in Arctic marine locations of critical importance to shipping traffic. The actual equipment is being developed by IOS under a separately-funded project and is not part of the TR&D allocations. |
| Status: | Active |
| Reports/Deliverables: | None to date. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

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|---|---|
| **Department:** | Fisheries and Oceans |
| **Project Title:** | Acoustic Remotely Controlled Submersible (ARCS) |
| **Project Number:** | 66309 |
| **1983/84 Expenditure:** | $500,000 |
| **Project Officer:** | A.J. Kerr - CHS Atlantic Region |
| **Contractor:** | 1) Brooke Ocean Technology Ltd.<br>2) International Submarine Engineering Ltd. |
| **Departmental Objective:** | To develop an autonomous remotely controlled vehicle for carrying out oceanographic and hydrographic research in ice-covered and ice-infested waters. |
| **Project Description:** | This is a program in which an un-manned submersible is placed through a hole in the ice. The submersible motors around a fairly large area collecting data as it goes, returning to the hole for fuel and to return the data it has collected. |
| **Status:** | Active<br>- design of vehicle completed<br>- equipment purchased and construction started |
| **Reports/Deliverables:** | None to date. |
| **Industrial/Technical/ Scientific Opportunity:** | There is a growing interest, particularly in the private sector, in ARCS as a geophysical survey platform. |

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|---|---|
| Department: | Fisheries and Oceans |
| Project Title: | Clearance Sweeping of Navigation Corridor |
| Project Number: | 66310 |
| 1983/84 Expenditure: | $66,000 |
| Project Officer: | R. Burke - CHS Atlantic Region |
| Contractor: | 1) Marinav (feasibility study)<br>2) Navitronic Ltd., Aarhus, Denmark (electronics) |
| Departmental Objective: | To develop the instrumentation and carry out clearance sweeping in Arctic Harbours and Approaches as required by the Termpol Code Regulations. |
| Project Description: | To assess the specifications of, and develop a vertical acoustic sweep system suitable for use in Arctic waters and which could be deployed from a survey launch. |
| Status: | Completed. |
| Reports/Deliverables: | Final report on feasibility study is currently available. |
| Industrial/Technical/ Scientific Opportunity: | N/A |

ENVIRONMENT (DOE)

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|---|---|
| **Department:** | Environment |
| **Project Title:** | Marine Forecast System |
| **Project Number:** | 1a) Wave, Freezing Spray/Marine Weather Climatology<br>1b) Arctic System Design and Adaptation of Forecast Procedures |
| **1983/84 Expenditure:** | 1a) $ 20,500<br>1b) $148,400 |
| **Project Officer:** | 1a) W.I. Pugsley<br>1b) E.C. Jarvis |
| **Contractor:** | 1a) Canada Systems Group<br>1b) P.G.F. Consulting and Maintenance Services Ltd.; ACRES Consulting Services; H.G. Engineering; Meteorological and Environmental Planning Ltd. |
| **Departmental Objective:** | The work supports the following AES goals:<br>a) to ensure that the service is meeting the needs of Canadians by improving weather services to the North and isolated areas<br>b) to improve the efficiency and effectiveness of marine services by implementing sea state information services, including development of procedures and systems to achieve implementation. |
| **Project Description:** | To develop systems and data bases for:<br>i) a wave climatology<br>ii) a freezing spray and marine weather climatology suitable for supporting Arctic Marine Transportation<br>iii) systems design of Marine Forecast Systems (MAST) for Arctic applications.<br>iv) wave, freezing spray and marine weather forecasting in real time for supporting Arctic Marine Transportation. |

v) development of a computer system for manual entry of graphical wave height data for updating wave data bases.

**Status:** Active

**Reports/Deliverables:**

- First version of MAST and a draft description have been received and are undergoing revision.
- Final report on design plan and output specifications received and accepted.
- Report on development of the prototype freezing spray prediction system (Report No. OSE82-0019).
- Report on modification of the perfect prog data base to provide for model output statistics development (Report No. OSE83-00337).
- Report on development of the graphical data entry system (Report No. OAJ88-00277).
- Report on testing and future application of the Donelan lakewave model (MSRB Report 83-4).

**Industrial/Technical/ Scientific Opportunity:** The work will enhance the Canadian capability for operational and marine forecasting in the Arctic and increase scientific knowledge of Arctic environmental conditions.

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|---|---|
| Department: | Environment |
| Project Title: | Microwave Sensing of Ice |
| Project Number: | 2a) NIMBUS Data Evaluation<br>2b) Iceberg Detectability/Meltpond Climatology<br>2c) SLAR Quantification |
| 1983/84 Expenditure: | $200,000 |
| Project Officer: | 2a) b) and c) Dr. R. O. Ramseier |
| Contractor: | 2a) Ph. D. Associates Inc.<br>2b) Polar Research and Enegineering<br>2c) F.G. Bercha and Associates |
| Departmental Objective: | The work is in support of the AES goal to ensure that the service is meeting the needs of Canadians by improving weather services to the North and in isolated areas. |
| Project Description: | 2a) Passive microwave data originating from the scanning multifrequency microwave radiometer on the NIMBUS-7 satellite is used to derive ice parameters and ice information products for use in marine navigation, initiating and updating ice dynamics models.<br><br>2b) The purpose of this study is to determine what limitations, if any, there are to the detection of icebergs using SLAR. Three important variables are examined: (1) depression angle; (2) aspect angle; (3) scale and swath width. The study is limited to the detection of icebergs in sea ice as opposed to icebergs in an open water situation. The data sets collected were from areas and times of year where a virtually continuous ice sheet was present. This situation differs considerably from icebergs in an open water situation because of the variables involved in determining detectability, both in their relative importance and interrelationships. |

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| | 2c) | The general objective of the work was to develop a capability to distinguish morphologically differing summer ice types on the basis of digitized radar signature characteristics. |
| Status: | 2a) | Active |
| | 2b) | Closed |
| | 2c) | Closed |
| Reports/Deliverables: | 2a) | Numerous data products received (progress is significantly above average) |
| | 2b) | Draft report completed, final due July 1982 |
| | 2c) | Final report completed |
| Industrial/Technical/ Scientific Opportunity: | - | |

| | |
|---|---|
| Department: | Environment |
| Project Title: | Laser Profilometer |
| Project Number: | 3 |
| 1983/84 Expenditure: | $57,000 |
| Project Officer: | C. Ramplee-Smith<br>Atmospheric Environment Service<br>4905 Dufferin Street<br>Downsview, Ontario<br>M3H 5T4 |
| Contractor: | The re-design is being carried out by Optech Inc. |
| Departmental Objective: | This project will lead to a production-type laser profilometer. This instrument gathers sea-ice data required for the AES ice services program. |
| Project Description: | The project is progressing within the schedule and cost budget. |
| Status: | Active |
| Reports/Deliverables: | - |
| Industrial/Technical/ Scientific Opportunity: | The results of the redesign project may be turned into a marketable product. |

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|---|---|
| Department: | Environment |
| Project Title: | Oil Spill Studies and Contingency Planning |
| Project Number: | 4a) Risk Analysis<br>4b) Countermeasures<br>4c) Movement Prediction |
| 1983/84 Expenditure: | 4a), 4b) $106,000<br>4c) $52,700 |
| Project Officer: | 4a), 4b) Mr. Harry Whittaker<br>4c) Mr. E.C. Jarvis |
| Contractor: | 4a), 4b)<br>- S.L. Ross Environmental Research Ltd.<br>- H.G. Engineering Ltd.<br>- University of Sherbrooke<br>- Meteorogolical and Environmental Planning Ltd. |
| Departmental Objective: | 4a), 4b) The objective of this study is to assess the overall countermeasures capability in the event of an Arctic marine transportation oil spill, with particular attention to the capability provided by the federal government's resources. The objective is in keeping with DOE's main objective to protect the environment from the adverse impact of human activities.<br><br>4c) To develop and test an improved marine oil spill trajectory forecast model. |
| Project Description: | 4a), 4b) Igniter Requirements for a Major Oil Spill from a Vessel in the Canadian Arctic. A previous study established that use of igniters was the most effective means of cleaning up oil spilled in a tanker accident in the Arctic. This study investigated the problems involved in the manufacture, supply and deployment of the igniters. |

4b) A Study of On-Board Self-Help Oil Spill Countermeasures for Arctic Tankers. This study investigated which measures were available to a tanker to reduce the amount of oil spilled and to clean up spilled oil in the event of an accidental discharge.

4c) Viability of the marine oil spill trajectory forecast system tested in 1983 COOSRA Oil spill sea trials. Simulation-runs of the model were made and weaknesses identified and corrected. An automated surface wind streamline depiction system was developed for assisting in the determination of wind - driven components of spill movement.

Status: Active

Reports/Deliverables:

1) Report on operational uses of AES oil spill system for 1983 offshore dispersant trials (Report No. OSE83-00158).

2) Report on development of an automated wind streamline production system (Report No. OSE83-00150).

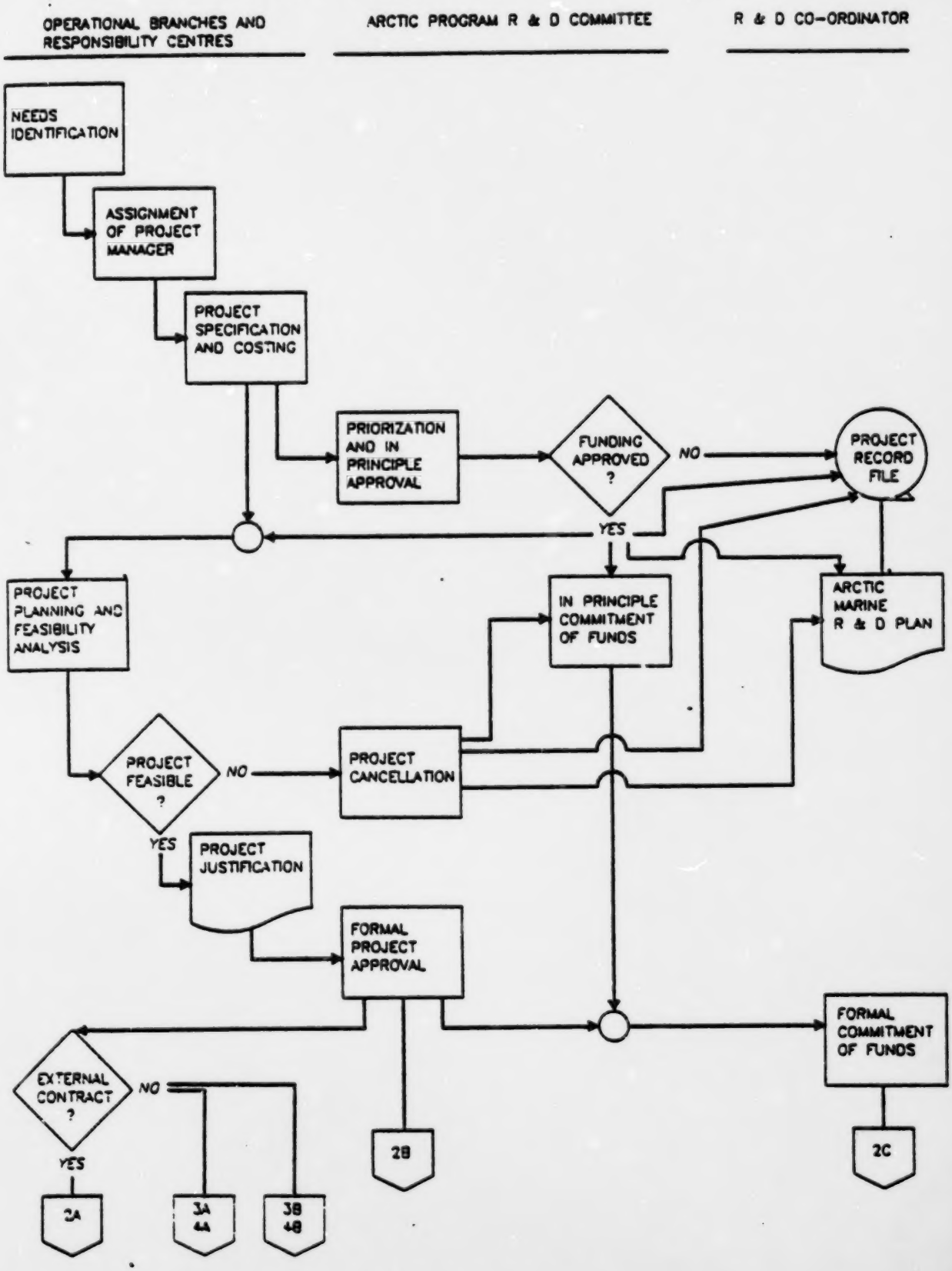
Industrial/Technical/ Scientific Opportunity: The study may provide incentive to Canadian industry to develop new or improved equipment.

The identification of the lead times involves should lead to the requirement for manufacture of devices as a precautionary measure. New technology in tanker design should also result.

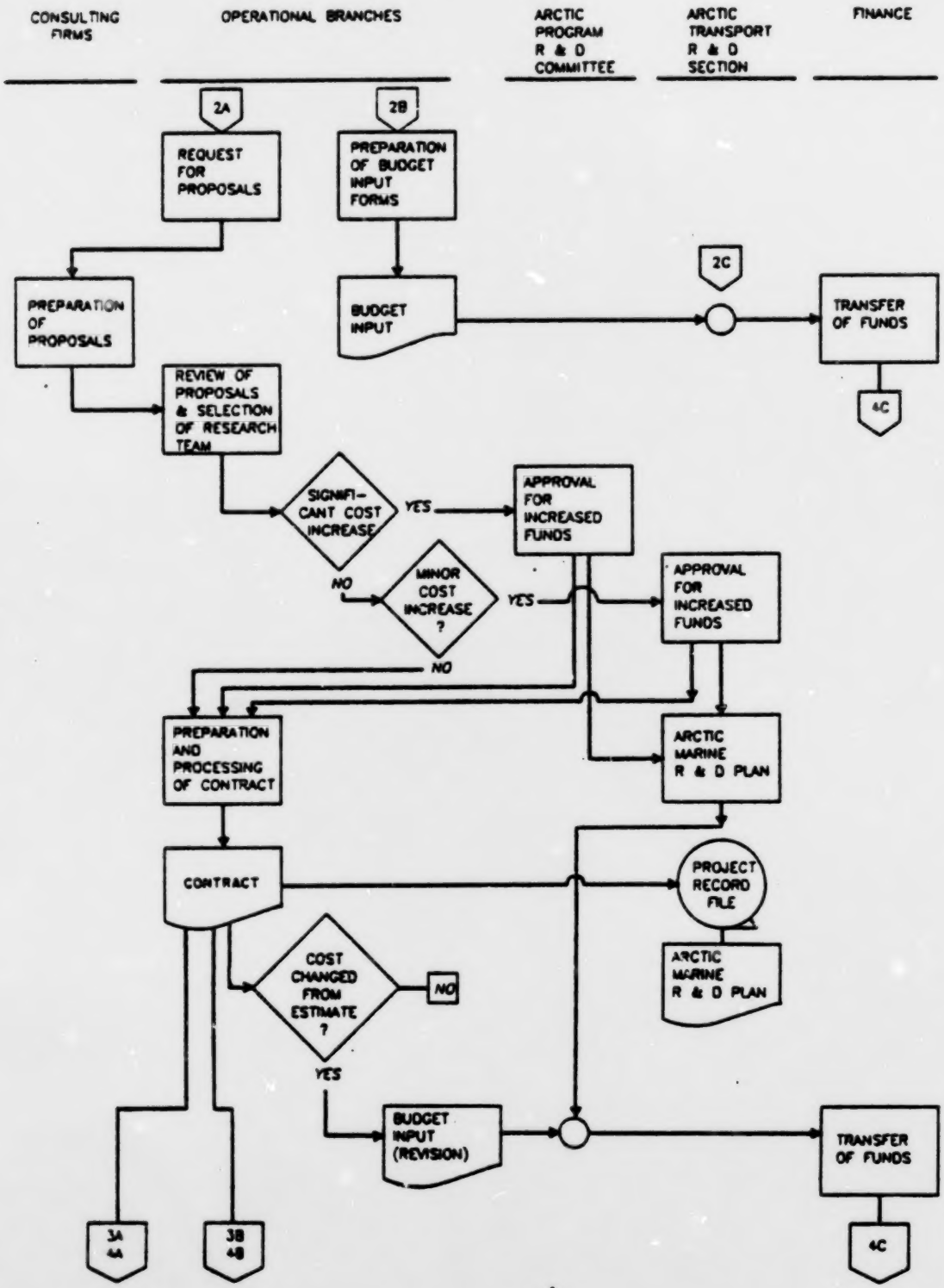
The AES oil spill model has been transferred to the private sector through the PILP program and marketed successfully nationally and internationally.

# APPENDIX A

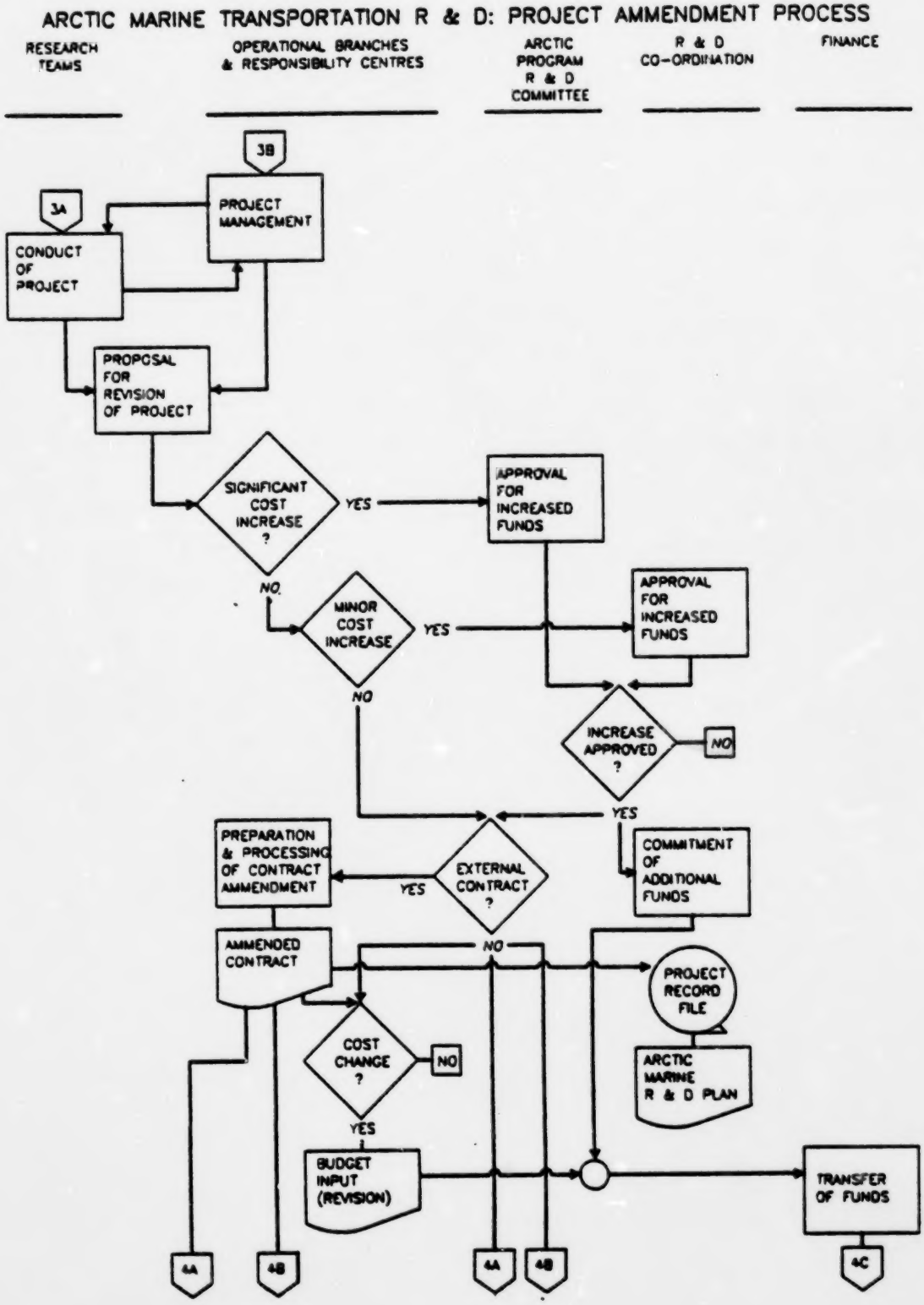
# ARCTIC MARINE TRANSPORTATION R & D: PROJECT APPROVAL PROCESS



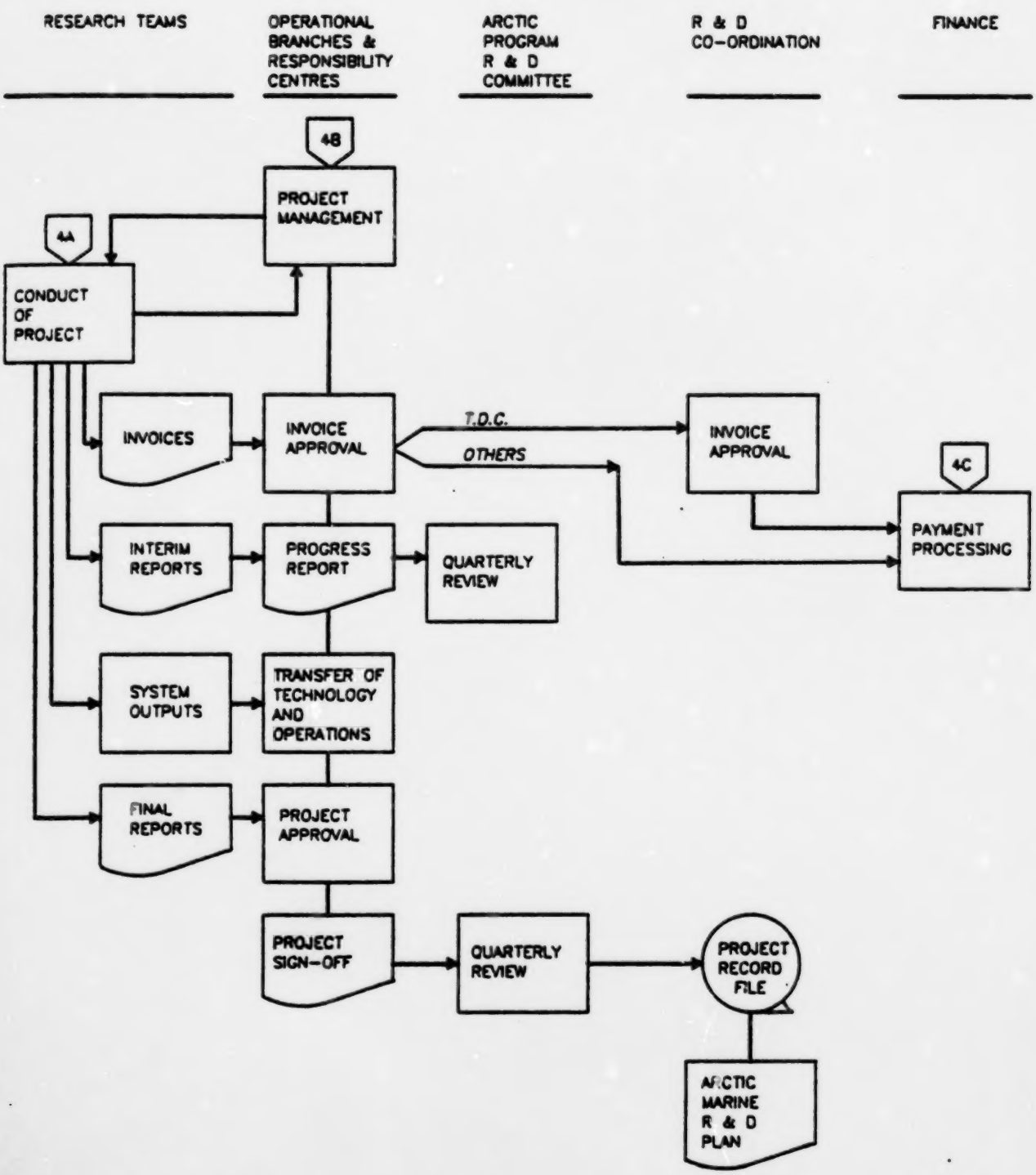
# ARCTIC MARINE TRANSPORTATION R & D: CONTRACT ASSIGNMENT PROCESS & INITIAL BUDGET INPUT



# ARCTIC MARINE TRANSPORTATION R & D: PROJECT AMMENDMENT PROCESS



# ARCTIC MARINE TRANSPORTATION R & D: CONDUCT AND COMPLETION OF PROJECTS



# KEY TO SYMBOLS AND ADDITIONAL DETAILS

1. ACTIVITIES/PROCESSES

2. DOCUMENTS/FORMS

3. DATA BANK/INFORMATION FILE

4. DECISION SWITCH POINT

5. FLOW OF ACTIVITIES/ CAUSAL CONNECTIONS 

6. ACTIVITY FLOW JUNCTION

7. ACTIVITY FLOW TERMINATION

8. OFFPAGE CONNECTOR

9. OPERATIONAL BRANCHES AND RESPONSIBILITY CENTRES:

TRANSPORT CANADA:
- CANADIAN COAST GUARD
- PILOTAGE AUTHORITIES
- ST. LAWRENCE SEAWAY AUTHORITY
- CANARCTIC SHIPPING COMPANY LIMITED
- PORTS CANADA
- HABOURS AND PORTS
- TRANSPORT DEVELOPMENT CENTRE
- MARINE PLANNING PROGRAMMING AND FINANCE

FISHERIES AND OCEANS CANADA:
- CANADIAN HYDROGRAPHIC SERVICES
- OCEAN SCIENCE AND SURVEYS

ENVIRONMENT CANADA: ATMOSPHERIC ENVIRONMENT SERVICE

10. RESEARCH AND DEVELOPMENT CO-ORDINATION

TOTAL PROGRAM: MARINE ENERGY AND R & D (TRANSPORT CANADA) AND INTERDEPARTMENTAL COMMITTEE ON ARCTIC MARINE R & D

TRANSPORT CANADA: MARINE ENERGY AND R & D AND CMTA R & D COMMITTEE

FISHERIES AND OCEANS CANADA: PLANNING & DEVELOPMENT DIRECTORATE

ENVIRONMENT CANADA: METEORLOGICAL SERVICES RESEARCH BRANCH

# ARCTIC MARINE TRANSPORTATION R & D: PROGRAM LOGIC MODEL